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|  | **PENNSYLVANIA**  **PUBLIC UTILITY COMMISSION**  Harrisburg, PA. 17105-3265 |  |

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|  | Public Meeting held December 19, 2013 |
| Commissioners Present: |  |

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| Robert F. Powelson, Chairman | | |  |
| John F. Coleman, Jr., Vice Chairman | | |  |
| James H. Cawley | | |  |
| Pamela A. Witmer  Gladys M. Brown | | |  |
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| Implementation of the Alternative Energy Portfolio  Standards Act of 2004: Standards for the Participation  of Demand Side Management Resources – Technical  Reference Manual 2014 Update | Docket No. M-2012-2313373  M-00051865 |

**2014 TRM ANNUAL UPDATE FINAL Order**

Table of Contents

[BACKGROUND 6](#_Toc374452806)

[DISCUSSION 8](#_Toc374452807)

[A. General Improvements 9](#_Toc374452808)

[1. Using the TRM – Determining Ex-Ante Savings 9](#_Toc374452809)

[2. Option to use Alternative Methods for Calculating Savings 10](#_Toc374452810)

[3. Measure Retention and Persistence of Savings 12](#_Toc374452811)

[4. Coincidence Factors 13](#_Toc374452812)

[5. Discussion of Thresholds and use of the TRM to Determine Ex-Ante and Ex-Post Savings 15](#_Toc374452813)

[6. Definitions 29](#_Toc374452814)

[7. Measure Lives 31](#_Toc374452815)

[8. Update of Custom Measure Protocols for the C&I Sector and Clarification of Mass Market Protocols for Residential Sector 32](#_Toc374452816)

[9. Baselines for Lost Opportunity and New Construction Measures 33](#_Toc374452817)

[10. Measure Interactions 36](#_Toc374452818)

[11. Weather Mapping for C&I Refrigeration Measures 38](#_Toc374452819)

[12. Determination of HVAC Energy Savings 40](#_Toc374452820)

[B. Additional Residential EE&C Measure Protocols 41](#_Toc374452821)

[C. Additional Commercial and Industrial EE&C Measure Protocols 42](#_Toc374452822)

[1. Fuel Switching – Electric Water Heater to Gas, Oil and Propane Water Heater and Fuel Switching – Heat Pump Water Heater to Gas, Oil and Propane Water Heater 43](#_Toc374452823)

[2. Fuel Switching – Electric Heat (Baseboard, Furnace, ASHP) to Gas, Oil and Propane Heaters 45](#_Toc374452824)

[D. New Agricultural EE&C Measure Protocols 47](#_Toc374452825)

[1. Variable Speed Drive Controller on Dairy Vacuum Pumps 47](#_Toc374452826)

[2. Automatic Milker Take-offs 49](#_Toc374452830)

[3. Dairy Scroll Compressors 50](#_Toc374452834)

[4. Low Pressure Irrigation Systems 51](#_Toc374452838)

[5. Livestock Waterers 52](#_Toc374452842)

[6. Heat Reclaimers 53](#_Toc374452846)

[7. High Efficiency Ventilation Fans with and without Thermostats 54](#_Toc374452851)

[E. Existing Residential EE&C Measure Protocols and Processes 55](#_Toc374452852)

[1. Electric HVAC Protocols 55](#_Toc374452853)

[2. ENERGY STAR Lighting 62](#_Toc374452854)

[3. Wall and Attic Insulation - Un-Insulated Wall R-Value 78](#_Toc374452855)

[4. Residential New Construction Protocols 80](#_Toc374452856)

[5. Ductless Heat Pump 82](#_Toc374452857)

[6. ENERGY STAR Appliances 85](#_Toc374452858)

[7. Water Heating Measure Protocols 91](#_Toc374452859)

[8. Low Flow Faucet Aerators 99](#_Toc374452860)

[9. Low Flow Showerheads 103](#_Toc374452861)

[10. Residential Occupancy Sensors 105](#_Toc374452862)

[11. Room AC Retirement 106](#_Toc374452863)

[12. Programmable Thermostat 108](#_Toc374452864)

[13. Pool Pump Load Shifting 108](#_Toc374452865)

[14. Variable Speed Pool Pump 109](#_Toc374452866)

[15. Furnace Whistle 111](#_Toc374452867)

[16. Smart Plug Outlets 112](#_Toc374452868)

[17. Refrigerator/Freezer Recycling 115](#_Toc374452869)

[18. Electroluminescent and LED Nightlights 117](#_Toc374452870)

[19. Holiday Lights 118](#_Toc374452871)

[20. ENERGY STAR Window 119](#_Toc374452872)

[21. Fuel Switching: Electric Heat to Gas, Propane and Oil Heat 120](#_Toc374452873)

[22. Residential Behavior-Based Programs 121](#_Toc374452874)

[23. Home Performance With ENERGY STAR 122](#_Toc374452875)

[24. Duct Sealing (New Measure) 123](#_Toc374452876)

[F. Commercial and Industrial EE&C Measure Protocols and Processes 125](#_Toc374452877)

[1. Lighting Protocols 125](#_Toc374452878)

[2. Premium Efficiency Motors and Variable Frequency Drive Improvements 135](#_Toc374452879)

[3. Variable Frequency Drive Improvement for Industrial Air Compressors 140](#_Toc374452880)

[4. HVAC Systems 141](#_Toc374452881)

[5. Electric Chillers 146](#_Toc374452882)

[6. High-Efficiency Refrigeration/Freezer Cases 146](#_Toc374452883)

[7. ENERGY STAR Office Equipment 147](#_Toc374452884)

[8. Smart Strip Plug Outlets 149](#_Toc374452885)

[9. High-Efficiency Ice Machines 150](#_Toc374452886)

[10. Wall and Ceiling Insulation 151](#_Toc374452887)

[11. Strip Curtains for Walk-In Freezers and Coolers 154](#_Toc374452888)

[12. Water Source and Geothermal Heat Pumps 156](#_Toc374452889)

[13. Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons 159](#_Toc374452890)

[14. ENERGY STAR Electric Steam Cooker 162](#_Toc374452891)

[15. Office Equipment – Network Power Management Enabling – Deemed Savings Values 163](#_Toc374452892)

[16. Refrigeration – Door Gaskets for Walk-in and Reach-in Coolers and Freezers – Deemed Savings Values 164](#_Toc374452893)

[17. Electric Resistance Water Heaters and Heat Pump Water Heaters 165](#_Toc374452894)

[18. LED Channel Signage 166](#_Toc374452895)

[19. Low Flow Pre-Rinse Sprayers for Retrofit Programs 167](#_Toc374452896)

[20. Low Flow Pre-Rinse Sprayers for Time of Sale / Retail Programs 168](#_Toc374452897)

[21. Small C/I HVAC Refrigerant Charge Correction 169](#_Toc374452898)

[22. ENERGY STAR Room Air Conditioners 170](#_Toc374452899)

[23. Variable Speed Refrigeration Compressor 171](#_Toc374452900)

[G. Appendix C (Lighting Inventory Tool) 173](#_Toc374452901)

[H. Appendix D (Motors and VFD Savings Calculator) 175](#_Toc374452902)

[I. Appendix E (New Construction Calculator) 176](#_Toc374452903)

[J. Application of the TRM 177](#_Toc374452904)

[CONCLUSION 180](#_Toc374452905)

**BY THE COMMISSION:**

As explained in our Order, entered June 1, 2009 at Docket No. M-00051865, in implementing the Alternative Energy Portfolio Standards Act (AEPS Act), 73 P.S. §§ 1648.1‑1648.8 and 66 Pa. C.S. § 2814,this Commission had adopted an *Energy‑Efficiency and DSM Rules for Pennsylvania’s Alternative Energy Portfolio Standard, Technical Reference Manual* (TRM).[[1]](#footnote-1) In adopting the original version of the TRM, this Commission directed that the implementation and maintenance of the TRM be updated on a periodic basis.[[2]](#footnote-2) Additionally, in the Phase I *Energy Efficiency and Conservation Program* Implementation Order,[[3]](#footnote-3) this Commission adopted the TRM as a component of the Energy Efficiency and Conservation (EE&C) Program evaluation process. In that Phase I Implementation Order, this Commission also noted that “as the TRM was initially created to fulfill requirements of the AEPS Act, it will need to be updated and expanded to fulfill the requirements of the EE&C provisions of Act 129.”[[4]](#footnote-4)

Soon after the adoption of the EE&C Program Phase I Implementation Order, Commission staff initiated a collaborative process to review and update the TRM with the purpose of supporting both the AEPS Act and the Act 129 EE&C program that culminated in the adoption of the 2009 TRM on May 28, 2009.[[5]](#footnote-5) In adopting the 2009 TRM, the Commission recognized the importance of updating the TRM on an annual basis.[[6]](#footnote-6)

With regard to Phase II of the Act 129 EE&C Program, the Commission again adopted the TRM as a component of the EE&C Program evaluation process.[[7]](#footnote-7) The Phase II Implementation Order also recognized the importance of the continued use of an annual updating process for the TRM for Phase II.[[8]](#footnote-8) With this Final Order, the Commission advances the fifth annual update of the TRM to be applied beginning with the 2014‑2015 AEPS Act and Act 129 EE&C Program Phase II compliance year.

**BACKGROUND**

Act 129 of 2008, P.L. 1592, specifically directed this Commission to establish an evaluation process that monitors and verifies data collection, quality assurance and the results of each electric distribution company’s (EDC) EE&C plan and the EE&C program as a whole. *See* 66 Pa. C.S. § 2806.1(a)(2). To assist in meeting this obligation, the Commission contracted with GDS Associates, Inc. in August 2009 and again in February 2013, to perform these duties as the Act 129 Statewide Evaluator (SWE). As part of its duties, the SWE is to review the TRM and the Total Resource Cost Test Manual (TRC) and to provide suggestions for possible revisions and additions to these manuals. A program evaluation group (PEG)[[9]](#footnote-9) was formed to, among other things, provide guidance to the SWE in clarifying energy savings measurement protocols and plans by recommending improvements to the existing TRM and other aspects of the EE&C program. In addition, the Commission convened a Technical Working Group (TWG)[[10]](#footnote-10) meeting to discuss the proposed 2014 TRM updates.[[11]](#footnote-11)

As indicated above, the Commission has previously updated the TRM on four other occasions. On each occasion, the Commission used a process, similar to the current process that offers all stakeholders multiple opportunities to provide input, in an open and collaborative way.[[12]](#footnote-12)

The SWE, in collaboration with the PEG and staff from the Commission’s Bureau of Technical Utility Services (TUS), with input from the TWG, reviewed the 2013 TRM and proposed several changes and additions that were released for comment on August 29, 2013.[[13]](#footnote-13) A notice of the Tentative Order and proposed 2014 TRM update was published in the Pennsylvania Bulletin on September 14, 2013.[[14]](#footnote-14) Comments were due on October 15, 2013 with reply comments due October 24, 2013.

The following parties filed comments to the proposed 2014 TRM update: Citizens for Pennsylvania’s Future and the Keystone Energy Efficiency Alliance (PennFuture/KEEA); Duquesne Light Co. (Duquesne); the Energy Association of Pennsylvania (EAP); Metropolitan Edison Co., Pennsylvania Electric Co., Pennsylvania Power Co. and West Penn Power Co. (collectively, FirstEnergy); PECO Energy Co. (PECO); and PPL Electric Utilities Corp. (PPL). The following parties filed reply comments to the proposed 2014 TRM update: PennFuture/KEEA, FirstEnergy, PECO and PPL.

**DISCUSSION**

The changes and improvements to the TRM are based on more recent research, a review of TRMs from other states, the needs and experiences of the EDCs and the comments provided. The EDCs provided, through the SWE evaluation and verification process, much of the data that forms the basis of the changes and improvements being adopted in the 2014 version of the TRM. Specifically, the current improvements were the result of SWE site inspections, and conservation service provider (CSP) and EDC independent evaluator comments. The adopted changes focus on improving assumptions for key parameters, algorithms, deemed savings values and accounting for new codes and standards for existing EE&C measures. The Commission believes that these adopted changes will make the TRM a more effective and professional tool for validating energy savings and providing support for the Act 129 goals. The major goals of the modifications are as follows:

1. To add protocols for EE&C measures being implemented by the EDCs ;
2. To balance the integrity and accuracy of claimed energy savings estimates with costs incurred to measure and verify the claimed energy savings;
3. To clarify existing calculation methods;
4. To minimize the need for custom protocols;
5. To allow for the use of territory-specific data; and,
6. To reduce the burden on EE&C program and evaluation staff.

Below, we will discuss in more detail the more significant TRM changes and updates that are being adopted. Minor administrative and uncontested changes being adopted will not be discussed.

1. **General Improvements**
   1. **Using the TRM – Determining *Ex-Ante* Savings**

In its Tentative Order, the Commission proposed the addition of the following in order to clarify which TRM version the EDCs must use for calculating *ex-ante* savings:

For replacements and retrofits, the applicable date for determining which TRM version to use to estimate EDC claimed savings is the “in-service date” (ISD) or “commercial date of operation” (CDO) – the date at which the measure is “installed and commercially operable,” and when savings actually start to occur. This is analogous to when a commercial customer’s meter “sees” the savings under expected and designed-for operation. For most projects, this is obvious. For projects with commissioning, the CDO occurs after the commissioning is completed. For incented measures that have been installed, but are not being used because there is no occupant, or will not be used until another, unrelated installation/project is completed; the equipment is not “commercially operable.” For these projects, the CDO is the date at which the customer begins using the incented equipment, not the date at which the equipment is energized. For new construction, selection of the appropriate TRM must be based on the date when the building/construction permit was issued (or the date construction starts if no permit is required) because that aligns with codes and standards that define the baseline. Savings begin to accrue at the project’s ISD.[[15]](#footnote-15)

* + - 1. **Comments**

PECO states that the determination of the installed project’s applicable program savings year is not clear in the following sentence: “Savings begin to accrue at the project’s ISD.” PECO requests clarification to address projects that may be installed and operating for only part of a program year. PECO also recommends that the EDC be allowed to use current TRM guidelines for a measure with an ISD prior to the current program year. [[16]](#footnote-16)

* + - 1. **Disposition**

The Commission would like to clarify that the Act 129 targets should be measured based on the annual savings potential installed in the program year irrespective of when the measure was installed in the program year. The Commission directs the EDCs to follow the direction provided in the TRM that is current to the project.

* 1. **Option to use Alternative Methods for Calculating Savings**

In its Tentative Order, the Commission proposed a revision to the language in Section 1.1,[[17]](#footnote-17) regarding the purpose of the TRM, in order to reflect the direction provided by the SWE in the Phase II Evaluation Framework.[[18]](#footnote-18) This proposal would allow the use of an alternative method to calculate *ex-ante* savings and/or have an independent evaluator use a custom method to verify *ex-post* savings, instead of using the energy and demand savings values for standard measures contained in the TRM. The EDC would be required to report, in its quarterly and/or annual EDC report(s), the savings based on the TRM protocols, along with the savings utilizing its alternative method. Furthermore, the EDC would be required to justify why it deviated from the TRM’s protocols in the same quarterly and/or annual report(s) in which it provides its alternative calculation of savings. The Commission’s proposal merely required the EDCs to report savings based on the TRM protocols for measures covered by the TRM, in addition to reporting savings based on an alternative method selected by the EDC along with a justification for using the alternative method. The Commission and its Staff reserve the right, at any time, to request the EDC’s alternative methodology and calculation of savings in order to ensure its accuracy and legitimacy.

* + - 1. **Comments**

Duquesne states that, while it understands the need to justify deviations from the TRM, it believes the Commission’s proposal would require the tracking of two sets of baseline assumptions and savings, as well as extensive modifications to EDC tracking systems, which may be costly and time consuming. Duquesne asserts that it would experience greater administrative burdens and costs when using alternative methods of calculating savings whenever the TRM or applicable regulations are changed.[[19]](#footnote-19)

* + - 1. **Disposition**

While the Commission recognizes the additional work involved in providing two separate savings calculations for a measure, we maintain our position that the EDCs file such information. The TRM may only be a guidance document; however, by its nature, it is the default methodology for the calculation of savings for the EE&C Program. The Commission uses the TRM as a baseline for the determination of savings, off of which any alternatives would be compared. The SWE and Commission Staff have provided such direction throughout the course of Phase I and Phase II and we are simply formalizing this direction in the TRM. As such, we direct the EDCs that use an alternative methodology for the calculation of savings of a measure to provide that methodology and the reasoning behind the deviation from the TRM, as well as the savings calculated using the TRM methodology in its quarterly and annual reports.

* 1. **Measure Retention and Persistence of Savings**

In its Tentative Order, the Commission proposed language to clarify the difference between measure retention and savings persistence described in Section 1.11.2 of the 2013 TRM, consistent with the 2013 TRC Test Final Order.[[20]](#footnote-20)

* + - 1. **Comments**

Duquesne references language in Section 1.12.2 of the proposed 2014 TRM which states that “savings for a measure with a useful life of two years installed in the first program year of the Phase II cannot be counted toward the established reduction target unless another measure is installed or implemented to replenish the savings from the expired measure.”[[21]](#footnote-21) Duquesne believes that, based on this language, the EDCs could not count savings from a measure with a two-year useful life when installed in the first year of a three-year phase unless the measure is replaced. Duquesne notes that this methodology is inconsistent with other states’ programs and suggests that the TRM retain annualized energy savings.[[22]](#footnote-22)

PennFuture/KEEA disagrees with Duquesne’s request, noting the legitimacy of the concern, but asserting that the TRM, as written, represents current industry trends.[[23]](#footnote-23)

* + - 1. **Disposition**

The Commission rejects Duquesne’s request that we modify the requirements of Section 1.12.2 as we believe this issue has been addressed in the Phase II Implementation Order. The Phase II Implementation Order states that, if any measures are installed whose useful life expires before the end of the phase, another measure must be installed or implemented during that phase which replenishes the savings from the expired measure.[[24]](#footnote-24)

* 1. **Coincidence Factors**

The Commission did not propose updates to the coincidence factors (CFs) for measures in its 2014 proposed TRM. However, comments were received regarding the updating of the CFs for all TRM protocols.

* + - 1. **Comments**

PECO states that the CFs for many measures in the 2014 Tentative TRM were not updated to reflect the Commission’s proposed peak demand period. PECO recommends that the Commission review and update the CFs for all measures in order to be consistent with the new peak demand period. PECO further suggests developing hourly load profiles for all measures to derive a CF for any peak demand period.[[25]](#footnote-25)

PennFuture/KEEA states that the definition of the peak period for demand savings is inconsistent across measures in the TRM. PennFuture/KEEA questions the accuracy and comparability of peak demand savings estimates developed from the TRM for several specific measures. PennFuture/KEEA further notes that the TRM assumes a uniform CF for all air-source cooling and air source and packaged terminal heat pump measures, which are an average of CFs from nine different sources. PennFuture/KEEA recommends that, given the significant effect that local weather conditions, equipment sizing practices, and typical building envelope characteristics have on cooling coincident demand, as well as the likely differences in peak period definition among the various jurisdictions, better documentation should be provided to confirm the relevance of these values to Pennsylvania.[[26]](#footnote-26)

In its Reply Comments, PennFuture/KEEA states that the TRM must use a consistent and unambiguous peak period definition throughout in support of comments made by several EDCs. PennFuture/KEEA also agrees with PECO’s request that all CFs in the TRM be reviewed and revised accordingly to ensure consistency with the new peak period definition. Lastly, PennFuture/KEEA requests that the Commission clarify the peak period definition used to develop measure CFs when values are adopted from other jurisdictions.[[27]](#footnote-27)

* + - 1. **Disposition**

The Commission acknowledges PECO’s and PennFuture/KEEA’s comments that the TRM must use a consistent and unambiguous peak period definition to estimate peak demand savings across all measures in the TRM. The Commission agrees with PECO’s recommendation to investigate and update the CFs for all measures in the TRM, where appropriate, to reflect the new peak demand period. The Commission also recognizes the need to develop hourly load profiles for all measures in order to determine CFs. The Commission also believes that, by developing Pennsylvania-specific hourly load profiles, CF values for any peak demand period can be determined in the future. The Commission, however, believes that updates to CF values cannot be made without rigorous review. Therefore, the Commission directs the PEG to obtain, or develop where necessary, and evaluate the feasibility and appropriateness of load shapes for all existing measures and provide recommendations for future TRM updates.

In addition, the Commission notes that several parties recommend updating CF values for specific measures in the TRM. The Commission carefully reviewed the comments provided and made changes to address those comments where a simple resolution was possible. The changes that were implemented are discussed in the measure-specific sections of this Order.

The Commission agrees with PennFuture/KEEA’s request to provide more clarity about the peak period definition used to develop measure CFs when values are adopted from other jurisdictions. As such, the Commission has provided such clarification.

* 1. **Discussion of Thresholds and use of the TRM to Determine *Ex-Ante* and *Ex-Post* Savings**

The proposed 2014 TRM provided a standardized statewide methodology for calculating energy and demand savings and a consistent framework for estimating *ex-ante* (claimed) savings and *ex-post* (verified) savings. Specifically, the proposed 2014 TRM categorized all prescriptive measures into two categories: deemed measures and partially deemed measures. Methods used to estimate *ex-ante* and/or *ex-post* savings differ for deemed measures and partially deemed measures. Deemed measure protocols have specified deemed energy and demand savings values which require no additional measurement or calculation. These protocols also may contain an algorithm with stipulated variables[[28]](#footnote-28) to provide transparency into deemed savings values and to facilitate future updates to deemed savings values. Partially deemed measure protocols have algorithms with stipulated and open[[29]](#footnote-29) variables that require the measurement of certain parameters to calculate the energy and demand savings.

Customer-specific or program-specific information can be used for each open variable, resulting in multiple savings values for the same measure. The Commission’s proposed 2014 TRM included default values for some open variables; specifically for instances when customer-specific or program-specific information may be unavailable. The Commission proposed that the EDCs only be allowed to adjust those variables specifically identified as open variables to include customer-specific or program-specific information.

1. **Customer and Program Specific Data**

The Commission proposed that the EDCs, their CSPs and independent evaluators collect and apply customer-specific or program-specific data to the *ex-ante* and/or *ex-post* savings calculations for as many open variables as possible in order to reflect the most accurate savings values. Customer-specific data comes directly from the measure application form, application process and/or EDC data gathering. The Commission also proposed that site-specific data or information be used for measures with important variations in one or more input values (e.g. delta watts, efficiency level, equipment capacity, operating hours). In addition, stipulated variables and default values for some open variables provided in the proposed TRM would be based on evaluations completed in Pennsylvania or the best available measured or industry data from other jurisdictions or industry associations. The Commission’s proposal allowed the EDCs to use default values for open variables in the TRM if customer-specific or program-specific information is unreliable or unattainable.

* 1. **Comments**

Duquesne states that the proposed 2014 TRM prohibits the use of customer-specific or program-specific information to alter the stipulated variable for deemed measure protocols. Duquesne further notes that the 2014 TRM limits the use of customer-specific or program-specific information to variables specifically identified as open variables in partially deemed measure protocols. Duquesne asserts that the restriction on deemed measure protocols implies that TRM values should not be subject to evaluator correction or application of realization rates associated with evaluator findings of site-specific parameters that vary from TRM stipulated or listed values for open variables. In addition, Duquesne points out that the TRM is a living resource document that requires updates to reflect specific current Pennsylvania conditions.[[30]](#footnote-30)

* 1. **Disposition**

The Commission concurs with Duquesne that the TRM is a living resource document that requires updates to reflect current Pennsylvania conditions, as they become available. The Commission recognizes the need to update the TRM annually to improve the accuracy and reliability of savings. The Commission clarifies that the findings obtained from evaluations and statewide studies would be used in subsequent TRM updates. If the EDCs determine that any of the existing values for stipulated variables or default values for open variables warrant updates, the Commission directs the PEG to discuss these issues and provide recommendations for future TRM updates.

While customer-specific or program-specific information can be used for each open variable for the partially deemed measure protocols already identified in the 2014 TRM, the Commission directs the EDCs to use deemed values for stipulated variables. The Commission also directs the EDCs to use deemed values for stipulated variables for fully deemed measure protocols. The Commission reasserts that the EDCs are only allowed to adjust those variables specifically identified as open variables to include customer-specific or program-specific information. The Commission clarifies that the stipulated variables and default values for some open variables provided in the proposed TRM are based on evaluations completed in Pennsylvania or the best available measured or industry data from other jurisdictions or industry associations.

1. **Thresholds for Using Default Values**

In its Tentative Order, the Commission proposed the establishment of end-use specific savings thresholds[[31]](#footnote-31) for certain measure protocols in the 2014 TRM. These thresholds were proposed in order to ensure that customer-specific values are utilized for high-impact and high-uncertainty measures, such as HVAC or lighting retrofits in universities or hospitals that have diverse building types, and where those types of projects represent a significant share of program savings. For projects above the proposed threshold, EDCs would be required to collect customer-specific data at the measure level in order to calculate *ex-ante* and/or *ex-post* savings. The proposed 2014 TRM organized all measures into various end-use categories for which a kWh threshold would be established. If a project involves multiple measures or technology types that fall under the same end-use category, the savings for all those measures or technology types would be grouped together to determine if the project falls above a particular kWh threshold.[[32]](#footnote-32) The proposed 2014 TRM listed all the end-use categories and the sections for measures within a particular end-use category. For projects with savings above the established kWh threshold, the proposed TRM directed the EDCs to collect site-specific information for open variables used in the calculation of energy and demand savings. If savings for individual end-use categories within a project falls below the kWh threshold, the proposed TRM allowed the EDCs to gather customer-specific data or to use the default stipulated value for each open variable.

The SWE and the Commission carefully reviewed approaches used by other jurisdictions. Additionally, the SWE and the Commission performed a sensitivity analysis using different thresholds based on all of the partially deemed, non-custom energy efficiency measures implemented by all of the EDCs during Phase I. Based on this analysis, the Commission proposed thresholds that would allow for a balance between the level of evaluation rigor and the need for accurate savings estimates and the level of costs required to collect customer-specific data. The following table lists the Commission’s proposed end-use category kWh thresholds above which the CSPs and independent evaluators would be required to use customer-specific data for calculating energy and demand savings.

|  |  |
| --- | --- |
| **End-Use Category** | **Expected kWh Savings Threshold[[33]](#footnote-33)** |
| C&I Lighting | >= 500,000 kWh |
| C&I HVAC | >= 250,000 kWh |
| C&I Motors & VFDs | >= 250,000 kWh |
| C&I Building Shell | >= 250,000 kWh |

The Commission notes that the proposed thresholds would be subject to review and adjustment by the EDCs’ independent evaluators, in coordination with the SWE, to minimize the uncertainty of estimates.

* 1. **Comments**

PECO comments that the thresholds included in the TRM will result in challenges for the EDCs, their CSPs, and evaluators and recommends that the Commission revise these requirements, as necessary, in the event that they become an undue burden on the program participants. In addition, PECO recommends adding a kWh threshold for the Agricultural Equipment end-use category at ≥ 250,000 kWh.[[34]](#footnote-34)

PPL, FirstEnergy and EAP recommend increasing the metering threshold from >=500,000 kWh/yr to >=1,000,000 kWh/yr for the non-residential lighting end-use category. In addition, FirstEnergy recommends increasing the thresholds from >=250,000 kWh to >=500,000 kWh for the non-residential HVAC, the Motors & VFD, and the Building shell end-use categories. PPL and FirstEnergy note that their proposed thresholds provide a more reasonable balance between cost, customer intrusion and savings accuracy. PPL and FirstEnergy note that, based on the stratified sampling and actual historic participation in EE&C programs, the Commission-proposed thresholds are lower than are appropriate to meet the required criteria and will significantly increase costs for program implementation and evaluation. PPL and FirstEnergy believe that the inconvenience to the customers outweighs the possible benefits of improved accuracy. [[35]](#footnote-35)

PPL estimates that, pursuant to the proposed metering threshold, approximately 60 lighting projects would be metered, per program year, based on Program Year 4 (PY4) participation, an increase of over 800% compared to the existing threshold.[[36]](#footnote-36) PPL asserts that, at an estimated cost of $7,000 per project, the additional cost to meet the proposed threshold is approximately $420,000 per program year and over $800,000 for the remaining two program years. PPL further notes that the estimate is only for commercial lighting retrofit projects and thus, the additional cost will likely be higher. PPL believes it is more prudent to spend that money on rebates and incentives, instead of additional evaluation rigor. In addition, PPL states that the installation and removal of metering (light loggers) is intrusive to customers.[[37]](#footnote-37)

FirstEnergy states that, based on PY4 participation, raising the thresholds as recommended will reduce the number of metered sites by more than half, saving over $270,000 of metering and EM&V costs annually without jeopardizing the confidence in evaluated program savings. FirstEnergy notes that, while it understands that the TRM contains language that the thresholds are subject to adjustment by the EDCs’ evaluation contractors in coordination with the SWE as appropriate, it believes that higher thresholds are more appropriate as a default starting point.[[38]](#footnote-38)

Duquesne states that the requirement for metering should be based on uncertainty as opposed to size or expected savings. Duquesne asserts that appropriately rigorous baseline studies should be used to gather data needed to produce better bases for future TRM stipulated and listed building type variables and that the proposed metering requirements will serve to slow program production and increase administrative burdens.[[39]](#footnote-39)

In its reply comments, PennFuture/KEEA states that it agrees with the suggestions from other parties to modify the current connected load threshold to 1,000,000 kWh in savings. PennFuture/KEEA notes that it is uncertain if the increased EDC cost and customer intrusion are currently justified to generate more precise estimates of lighting hours of use (HOU) and CFs. PennFuture/KEEA recommends that the SWE review the data from the non-residential lighting projects to ascertain how well the HOU, CFs, and other key variables match current default assumptions before lowering the metering thresholds. In addition, PennFuture/KEEA recommends that the SWE consider using smart meters to reduce the costs and potential customer intrusion associated with end use metering. While PennFuture/KEEA agrees with the EDCs’ suggestion to increase the kWh thresholds for the non-residential lighting end-use category, it notes that the metering thresholds for variable frequency drives (VFDs) are reasonable and appropriate given the large amount of savings and possible variability in operating hours and profiles per metered site.[[40]](#footnote-40)

PPL recommends clarifying whether the metering applies to all projects above the threshold or only to those projects in the evaluation sample. PPL also suggests that, if both *ex-ante* and *ex-post* savings are to be calculated using site-specific inputs for projects above the threshold, the metering requirements be limited to the determination of *ex-post* savings. PPL further asserts that the methods for estimating site-specific inputs for *ex-ante* savings should be left to the discretion of the EDC.[[41]](#footnote-41)

FirstEnergy believes that the statement that “[s]ampling methodologies within a site are to be discerned by the EDC evaluation contractor and communicated to implementation contractors based on the characteristics of the facility in question” implies that EDC evaluators would need to do an in-depth review of all applications with claimed savings above 500 MWh. FirstEnergy recommends changes to the above-referenced language. FirstEnergy further comments that references to metering be modified to allow for supported exceptions where metering cannot be performed.[[42]](#footnote-42)

* 1. **Disposition**

For the reasons set forth below, the Commission rejects the request of PPL, FirstEnergy, EAP and PennFuture/KEEA to increase the threshold from >=500,000 kWh/yr to >=1,000,000 kWh/yr for the non-residential lighting end-use category. The Commission also rejects FirstEnergy’s recommendation to increase the thresholds from >=250,000 kWh to >=500,000 kWh for the non-residential HVAC, the motors & VFDs and the building shell end-use categories. The Commission accepts PennFuture/KEEA’s request not to change the thresholds for the motors & VFDs end-use category as the proposed thresholds are appropriate given the large amount of savings and variability in operating hours.

The thresholds recommended by the Commission were derived by performing a sensitivity analysis using different thresholds based on the actual historic participation in the EE&C programs for all seven EDCs during Phase I. Specifically, the SWE carefully analyzed all partially deemed and non-custom energy efficiency measures implemented by all seven EDCs from Program Year 2 (PY2) through PY4. Based on the analysis completed by SWE, the Commission believes that the proposed thresholds will balance the level of evaluation rigor and the need for accurate savings estimates with the level of costs required to collect customer-specific data.

Pursuant to the Commission’s proposed thresholds across various end-use categories, FirstEnergy estimated a total of 173 projects that would be required to meter based on PY4 participation alone. The SWE and the Commission compared FirstEnergy’s reported number of projects above the kWh thresholds to the count determined from SWE’s analysis based on the EDCs’ quarterly databases and the SWE was unable to replicate what FirstEnergy reported. The SWE found a total of 132 projects for the non-residential lighting category (average of 12 projects per quarter) and 32 projects for motors & drives and HVAC categories (average of 3 projects per quarter) from PY2 Quarter 1, through PY4 Quarter 3, that have savings above the Commission-proposed kWh thresholds. These figures are lower than the figures provided by FirstEnergy.

In order to justify a sampling precision requirement of 15% at the 85% confidence level and the relatively low resulting sample sizes, the Commission believes that verification approaches used for high-value projects within the sample should be rigorous and meaningful. The Commission, therefore, believes that the recommended thresholds will balance the level of evaluation rigor and the need for accurate savings estimates with the level of costs required to collect customer-specific data. As such, the Commission maintains its proposed thresholds.

Pursuant to the Commission’s proposed thresholds for non-residential lighting, PPL estimated that 60 lighting projects would be metered per program year based on PY4 participation and would result in an additional cost of $420,000 per program year and over $800,000 for the remaining two program years. PPL assumed that it would cost $7,000 per project to complete metering. A major portion of this cost was allotted to site visits alone. The breakdown is as follows: 3 people x 8 hours (including travel time) x 2 site visits (install & remove) x $100/man-hour = $5,000 for the site visits alone.

While the Commission recognizes that there would be additional cost involved with the equipment, preparation time, recruitment and analysis, the SWE and the Commission believe that these costs are highly inflated. While FirstEnergy reported a much lower cost figure ($3,000 per site) for metering and EM&V compared to PPL’s assumption, the Commission believes that the actual cost to conduct two site visits (for metering equipment install and removal) is significantly lower than PPL and FirstEnergy’s assumptions based on the findings from the SWE’s Phase I audit activities and the Phase II SWE Commercial Lighting Metering Study budget assumptions.[[43]](#footnote-43)

The Commission clarifies that the proposed thresholds would be subject to review and adjustment by the EDCs’ independent evaluators, in coordination with the SWE, to minimize the uncertainty of estimates. The Commission also clarifies that the thresholds for the 2014 TRM can be revisited during subsequent TRM updates and revised based on actual experience.

Although end-use metering is the preferred method of data collection for projects above the kWh threshold, the Commission reasserts that EDCs can use trend data from building monitoring systems, panel data and/or billing analysis as substitutes for calculating savings, where appropriate, to minimize the costs while maintaining accuracy. The Commission would also like to reiterate that the thresholds are intended to determine values for key variables for high impact measures and to verify savings at a high level of rigor for projects that account for the majority of the programs expected savings. As mentioned above, the Commission recognizes PECO’s comments regarding the need to revisit the threshold requirements, as necessary, in the event that they become an undue burden on the program participants. The Commission directs the PEG to monitor the implementation of the new thresholds and provide recommendations for future TRM updates.

The Commission accepts PECO’s recommendation to add a kWh threshold for the Agricultural Equipment end-use category at ≥ 250,000 kWh. Per PPL’s request, the Commission clarifies that the thresholds only apply to projects that are selected in the evaluation sample. The Commission, however, rejects PPL’s suggestion to limit the metering requirements to determining *ex-post* savings only for projects above the kWh thresholds. The Commission reiterates that it is at the discretion of the EDCs to choose whether to have its CSP meter projects to estimate *ex-ante* savings; to have the evaluator meter projects to determine *ex-post* savings; or both. The Commission further clarifies   
that, if metering is completed by the CSP, the evaluator can leverage the metered data subject to a reasonableness review.[[44]](#footnote-44)

The Commission accepts PPL’s request to allow the EDCs to determine which methods to use for estimating site-specific inputs for *ex-ante* savings. The Commission notes that it is not aware of any other methods than those already included in the TRM. In the 2014 TRM, the Commission recommends obtaining customer-specific data from the measure application form or application process and/or EDC data gathering, such as, facility staff interviews, posted schedules, BM), panel data, or metered data.

The Commission accepts FirstEnergy’s recommendation to modify the TRM language to read: “Sampling methodologies within a site are to be **either** discerned by the EDC evaluation contractor based on the characteristics of the facility in question **or performed consistent with guidance the EDC EM&V contractor provides**.” The Commission also accepts FirstEnergy’s suggestion to clarify the language in the TRM related to the metering requirements to allow for supported exceptions in cases where metering cannot be performed.

The Commission acknowledges PennFuture/KEEA’s recommendation to consider leveraging data from smart meters. The Commission also recognizes the need to investigate if there are opportunities to use smart meters to reduce the costs and potential customer intrusion associated with end use metering and, if so, how it affects proposed metering requirements for energy efficiency projects. The Commission, however, believes that special metering may be necessary to validate certain custom measures. In addition, the Commission notes that energy efficiency measures often only affect a small portion of the energy use in a facility and it can be difficult to assess the savings relative to the natural variation in operating conditions. The Commission refers PennFuture/KEEA’s suggestions to the PEG for discussion and to provide possible recommendations for future TRM updates.

1. **Clarifying Intention and Language**

Section 1.2 of the draft 2014 TRM provides a consistent framework for CSPs to estimate *ex-ante* (claimed) savings and for EDC evaluation contractors to estimate *ex-post* (verified) savings for the EE&C programs.

* 1. **Comments**

PECO suggests changes to Section 1.2.1 to provide better clarity. PECO notes also that the language in Sections 1.2.2 and 1.2.3 appear to contradict. PECO also provides recommendations for Section 1.2.3.[[45]](#footnote-45)

In Table 1-1, PECO recommends that agricultural equipment be included as a separate sector, rather than repeating section numbers in both the residential and C&I sectors. PECO also suggests that the “Hot Water” end-use category for both the residential and C&I sectors be changed to "Domestic Hot Water" in order to differentiate it from hot water systems used in HVAC or industrial process water loops. Thirdly, PECO proposes that the office equipment end-use category be renamed to “Electronics” to more accurately represent the technology types included in the end-use. PECO requests that Sections 2.6 and 2.38 be included in the Residential Domestic Hot Water end-use category and that Section 2.11 be removed from the HVAC category and included in the Residential Appliances category. Finally, PECO recommends the removal of Section 2.33 from the Residential Appliances category and included in the Residential Electronics (Office Equipment) category, as well as the inclusion of Section 2.20 in the Residential Building Shell category.[[46]](#footnote-46)

PPL suggests adding “annualized energy” and “peak demand savings” to the second paragraph of Section 1.1. PPL notes that these additions will provide clarity.[[47]](#footnote-47)

* 1. **Disposition**

The Commission recognizes the need for more clarity regarding the language, tables, and footnotes related to Section 1.2 of the 2014 TRM. The Commission adopts all of the changes proposed by PECO. Regarding the language in Sections 1.2.2 and Section 1.2.3, the Commission clarifies that the EDCs are required to collect and apply customer-specific or program-specific data for projects with savings at or above the established kWh thresholds. The EDCs have the option to use either default values, customer-specific or program-specific data for projects with savings below the thresholds.

Regarding the paragraph following Table 1-1, the Commission clarifies that billing analysis is an acceptable method of verification when customer-specific data is required. The Commission notes that billing analysis should be conducted using at least 12 months of billing data (pre- and post-retrofit). The Commission, however, accepts PECO’s proposed changes to Table 1-1. The Commission also agrees with PPL’s suggestion of adding “annualized energy” and “peak demand savings” to the second paragraph of Section 1.1.

* 1. **Definitions**

Section 1.3 of the proposed 2014 TRM lists the definitions for all important terms and major concepts that apply to the EE&C Programs. These definitions were not discussed in the Tentative Order. We did, however, receive comments on the definitions from several parties and will address those comments here.

* + - 1. **Comments**

PECO states that the definitions section is quite limited in scope and recommends expanding the list of definitions to include all major measure implementation types, and other major concepts discussed in the 2014 TRM. PECO recommends clarifying and revising definitions for the terms including “measure,” “technology type,” and “end-use” in Section 1.2.3. PECO also recommends modifying the definition for EDC Reported Gross Savings. Additionally, PECO and PPL suggest changing "Retrofit on Burnout (ROB)" to "Replace on Burnout (ROB)” to be more consistent with standard industry language. PECO further recommends edits for the “Retrofit on Burnout (ROB)” definition. In the New Construction, Retrofit and Substantial Renovation Measures, PECO suggests language changes. Furthermore, PECO proposes splitting the definition for Retrofit measures and Early Replacement measures, as well as combining the Substantial Renovation Measure definition with the New Construction Measure definition. To properly represent the different types of measures being offered in the EE&C programs, PECO recommends adding definitions for the following measure types: Direct Install (DI) measures, Efficiency Kits (KIT), Time of Sale (TOS) measures, and Early Retirement (ERET) measures. PECO also suggests definitions for Measure Life / Effective Useful Life (EUL) and Remaining Useful Life (RUL).[[48]](#footnote-48)

PPL recommends checking all the definitions to ensure consistency between definitions in the TRM and other documents. PPL also suggests that the definition for “EDC Reported Gross Savings” include “also known as *ex-ante* savings.” Additionally, PPL believes that the term “EDC Estimated Savings” should be deleted as it is not used in the TRM. PPL requests that the term “Verified Savings” be amended to “Verified Gross Savings” to ensure consistency with other savings terms. [[49]](#footnote-49)

Duquesne requests the removal of the provision in Section 1.3 stating: “retrofit measures have a dual baseline: for the estimated remaining useful life of the existing equipment the baseline is the existing equipment; afterwards the baseline is the applicable code, standard and standard practice expected to be in place at the time the unit would have been naturally replaced.” The basis for the request is an increased level of operational needs in order to track dual baselines for situations where two measures each have a partial useful life. [[50]](#footnote-50) PennFuture/KEEA disagrees with Duquesne’s request and reference the need for dual baselines in the instances where they are applicable.[[51]](#footnote-51)

* + - 1. **Disposition**

The Commission recognizes the need for more clarity in the TRM regarding the definitions and major concepts that apply to the EE&C programs. The Commission adopts most of the changes proposed by PECO and PPL. Definitions for the following have been added to the TRM: Direct Install (DI) measures, Efficiency Kits (KIT), Time of Sale (TOS) measures, Early Retirement (ERET) measures, Measure Life / Effective Useful Life (EUL), and Remaining Useful Life (RUL). The Commission, however, rejects PECO’s request to alter the provision defining the baseline equipment definitions. It is the opinion of the Commission that the definitions are inclusive of the measures that are relevant to the program and adding additional baselines would be redundant.

The Commission rejects the Duquesne’s request to remove the provision from the TRM guidelines at this time and agrees with PennFuture/KEEA that it remain. Clear definitions of the terms “early replacement” and “retrofit” measures have been added to the 2014 TRM. While we do acknowledge that there is an increased administrative requirement for determining multiple baselines for equipment, we must account for the fact that the industry minimum standards will continue to elevate past those standards that were in place when a measure was installed.

* 1. **Measure Lives**

Appendix A in the TRM contains measure lives for informational purposes and for use in other applications, such as reporting lifetime savings, or in benefit/cost studies. In the Tentative Order, the Commission proposed to update the list of measures in Appendix A to ensure that measure lives are included for all measure protocols in the TRM.

* + - 1. **Comments**

PECO comments that several sections continue to have a Measure Life subsection, even though there is a complete table in the updated Appendix A. PECO suggests the removal of such subsections. PECO further notes that, if there is supporting information to justify the measure life in the subsections, it should be moved to the Appendix A.[[52]](#footnote-52)

* + - 1. **Disposition**

The Commission rejects PECO’s suggestion of removing the measure lives subsection from all the measure protocols. The Commission believes that it is appropriate to include the measure lives and supporting sources within the measure protocols and does not see any value in completely removing these sections. The Commission also clarifies that it carefully reviewed and compared the measure lives in measure protocols to those in Appendix A for consistency.

* 1. **Update of Custom Measure Protocols for the C&I Sector and Clarification of Mass Market Protocols for Residential Sector**

In the Tentative Order, the Commission proposed that custom measure protocols (CMPs) be established in general conformity to the International Performance Measurement and Verification Protocol (IPMVP)[[53]](#footnote-53) or Federal Energy Management Program M&V Guidelines.[[54]](#footnote-54) All custom projects selected in the sample by the independent evaluator for verification would require a Site-Specific Measurement and Verification Plan (SSMVP), which would be developed by the EDC’s independent evaluator and available for SWE review. The SWE would reserve the right to audit and review the claimed and verified impacts of all custom measures. The Commission clarified that CMPs approved during Phase I are available for use in Phase II.[[55]](#footnote-55)

In addition, certain mass market programs in the residential sector are a subset of custom measures. These programs offer measures, or groups of measures, which are not included in the TRM. As with the CMPs, during Phase I of Act 129 the PEG developed mass market protocols (MMPs) for calculating the energy and demand savings associated with residential behavioral modification and low-income weatherization programs. The Commission proposed that MMPs approved during Phase I be available for use in Phase II. The SWE’s Phase II Evaluation Framework provides additional guidance regarding the gross impact evaluation of CMPs and MMPs without TRM savings protocols.

1. **Comments**

PPL recommends changing all references to CMPs to SSMVP.[[56]](#footnote-56) PECO states that there are several definitions that reference the CMP method and suggests the removal of all references to the CMP method. Finally, PECO and FirstEnergy suggest changes to Section 1.16.[[57]](#footnote-57)

1. **Disposition**

The Commission adopts the changes proposed by PECO, PPL and FirstEnergy.

* 1. **Baselines for Lost Opportunity and New Construction Measures**

While the Commission did not discuss the baselines for lost opportunity and new construction measures in the Tentative Order, we did receive comments on updating the baselines for such measures and will address those comments here.

* + - 1. **Comments**

PennFuture/KEEA states that the savings for nearly all lost opportunity measures are based on the difference in efficiency between a presumed baseline unit and the high efficiency measure installed as a result of the program. PennFuture/KEEA notes that for baselines the TRM typically defaults to federal standards minimums for nearly all appliances, domestic hot water and HVAC equipment. PennFuture/KEEA comments that the baseline, however, is some blended average of units at or above this minimum. Based on the ENERGY STAR shipment market share data, PennFuture/KEEA asserts that the market share for many covered products at or above the ENERGY STAR level is very high, which supports measure baselines above the federal minimum for nearly all of these measures. PennFuture/KEEA further notes that failure to properly account for the current high saturations of efficient products in the market will lead to overstatement of gross savings. PennFuture/KEEA recommends that the baselines for all key lost opportunity measures be revised accordingly. PennFuture/KEEA also asserts that, from a program design and implementation perspective, higher levels of program eligibility should be considered either in addition to or in place of ENERGY STAR. PennFuture/KEEA believes that this will allow the EDCs to maintain higher per-unit gross savings if baselines are revised. PennFuture/KEEA also advises better tracking the efficiencies of program supported equipment.[[58]](#footnote-58)

In addition, PennFuture/KEEA states that experience in other jurisdictions indicates that full compliance with the IECC of 2009 is unlikely. PennFuture/KEEA notes that new construction baseline and code compliance studies show that current construction practices are, on average, below those mandated by code. As such, PennFuture/KEEA recommends that the Commission assess the status of code compliance and develop better new construction baselines and savings estimates. PennFuture/KEEA further suggests that, until these Pennsylvania studies are completed, the SWE should survey studies in other jurisdictions.[[59]](#footnote-59)

FirstEnergy, PECO and PPL oppose PennFuture/KEEA’s recommendations and support the current practice of referencing federal standards for determination of baselines given the: a) lack of Pennsylvania-specific data; b) challenges associated with accurately characterizing industry practice; c) absence of market studies that could characterize standard industry practice; and, d) ability to capture free-ridership through net-to-gross assessments. FirstEnergy and PECO recommend that baselines be changed when definitive Pennsylvania specific research supports such a change. PPL proposes that the Commission consider updating the baselines identified by PennFuture/KEEA as part of the ongoing baseline and market potential studies. PPL and FirstEnergy further state that many of PennFuture/KEEA’s suggestions be addressed during a future potential Phase of Act 129, rather than during the mid-Phase II Plan cycle.[[60]](#footnote-60)

In response, PennFuture/KEEA states that codes and standards often make for very poor baseline assumptions. PennFuture/KEEA note that the TRM must establish proper baselines and not defer to codes or standards for mere convenience.[[61]](#footnote-61)

* + - 1. **Disposition**

The Commission agrees with PennFuture/KEEA that it may be worthwhile to investigate recently completed code compliance and new construction baseline studies in other jurisdictions. As such, we direct the PEG to undertake this research and provide recommendations for future TRM updates.

We also agree with FirstEnergy, PECO and PPL regarding the continuance of the current practice of referencing federal standards for determination of baselines in the TRM. The Commission agrees with PPL’s recommendation to consider updating the baselines based on the Phase II SWE Statewide Residential and Commercial & Industrial Baseline and Potential Studies. The Commission further recommends that the program eligibility requirements be revisited during the program design for a future potential Phase of Act 129 programs based on the findings from Phase II SWE Statewide studies.

* 1. **Measure Interactions**

Section 1.12.3 specified which measures and/or programs have measure interactions. This topic was not discussed in the Tentative Order. We did, however, receive comments on this topic and will address those comments here.

* + - 1. **Comments**

PennFuture/KEEA states that the programs or measures specified in the introduction section of the TRM as having measure interactions considered is limited. PennFuture/KEEA notes that the residential lighting measure descriptions include specific factors for the inclusion of interactive impacts on heating and cooling loads. However, the Home Performance program description contains no such explicit adjustments. PennFuture/KEEA suggests that, as these program/measure impacts appear to be modeled, such building lighting/envelope/HVAC system interactions should be considered as part of the modeling process and that the EDCs should be required to estimate these impacts. PennFuture/KEEA further asserts that, for C&I programs, there should also be similar consideration of lighting impacts on heating loads, new construction program measure interactions, as well as retrofit shell/HVAC interactions. PennFuture/KEEA recommends expanding the number and types of programs for which building interactions must be considered.[[62]](#footnote-62)

FirstEnergy states that Section 1.12.3 of the TRM addresses the interaction of the measures as they pertain to the building but not the interaction of lighting and appliances within the home energy rating tool. FirstEnergy further insists that additional calculations are required to account for the effects of lighting and appliances in order to compare the efficient building to the baseline scenario. As a result, FirstEnergy recommends the removal of the entire statement: “For Residential New Construction, the interaction of energy savings is accounted for in the home energy rating tool that compares the efficient building to the baseline or reference building and calculates savings.”[[63]](#footnote-63)

* + - 1. **Disposition**

The Commission agrees with PennFuture/KEEA’s recommendation of expanding the number and types of programs for which building interactions must be considered. The Commission also agrees with PennFuture/KEEA that measure interactions should be considered for any program or measure for which savings are modeled. The Commission, however, believes that the proposed changes require significant research. Due to the complexity of the recommendations, the Commission directs the PEG to evaluate the feasibility of considering measure interactions for the proposed measures and to provide recommendations for future TRM updates.

The Commission rejects FirstEnergy’s request to remove the sentence describing the interaction of the efficient building and the baseline scenario in the energy rating tool. As referenced in Section 2.22.1, the home energy rating tool REM/Rate being used in this justification has a requirement for lighting inputs and uses a default value in its baseline as a comparison based on square footage of the code minimum building. To clarify the intent of the statement in Section 1.12.3, the interaction is accounted for in the energy rating tool in both baseline and efficient scenarios, but can be manually adjusted.

* 1. **Weather Mapping for C&I Refrigeration Measures**

Several commercial refrigeration protocols in the 2013 TRM (Sections 3.23, 3.24 and 3.25) rely on the work and analysis completed in California. The source equations, values for input parameters and deemed savings values were adopted from the Database for Energy Efficient Resources (DEER).[[64]](#footnote-64) The values for each Pennsylvania reference city were taken from the associated California climate zones listed in the California work paper to account for differences in climate. Each of the seven reference Pennsylvania cities are mapped to a California climate zone as shown in Table1-2 based on the comparable number of cooling degree days and average dry bulb temperatures. These protocols use California-based models and follow the mapping table in the TRM. The methodology of mapping Pennsylvania cities to California climate zones to account for differences in weather was discussed in the 2013 TRM Final Order.[[65]](#footnote-65)

In the Tentative Order, the Commission proposed to update the deemed savings values based on feedback from the PEG. The Commission mapped Pennsylvania cities to California climate zones based on comparable number of cooling degree hours and wet bulb temperatures to produce more accurate deemed savings values. In addition, reference to the weather mapping table was clearly mentioned in the protocol to clarify which protocols rely on the mapping table. Although this estimation may not be perfect, it serves as a reasonable proxy to translate savings from the DEER or the California work papers. The Commission further clarified that, due to the relatively small contribution of savings and lack of Pennsylvania-specific data, the *ex-ante* savings from DEER will be used until Pennsylvania-specific research is conducted.

1. **Comments**

PECO states that it is not clear if the California climate zones chosen are appropriate. PECO notes that California climate zones 4, 9 and 15 may have similar cooling degree hours as Pennsylvania cities; however, they are not proper mappings based on the type of climate zone they represent. PECO further states that the only California climate zone that is in the same American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE) climate zone as Pennsylvania is California climate zone 16, which also has the closest heating degree days (HDD) and cooling degree days (CDD) to the Pennsylvania cities being mapped. PECO also asserts that it is probably the closest representative California climate zone to Pennsylvania weather. PECO recommends reconsidering the weather mapping Table 1-4 and used in the various commercial refrigeration measure protocols.[[66]](#footnote-66)

1. **Disposition**

The Commission rejects PECO’s request to revise the weather mapping and update the deemed savings for various commercial refrigeration measure protocols. The Commission clarifies that the weather mapping using cooling degree hours was done based on the feedback received from the PEG. The Commission further notes that it is not aware of any data that shows California climate zone 16 having the closest HDD and CDD to the seven Pennsylvania cities mapped. However, the Commission believes this may warrant further review. As such, the Commission directs the PEG to review such data, evaluate its feasibility and appropriateness and provide recommendations for future TRM updates. The Commissions reiterates that this estimation serves as a reasonable proxy to translate savings from the DEER or the California work papers. Until Pennsylvania-specific research is conducted and/or better weather mapping methodology becomes available, the Commission directs the EDCs to use weather mapping Table 1-4 and the deemed savings included in the 2014 TRM.

* 1. **Determination of HVAC Energy Savings**

In the Tentative Order, the Commission discussed updating the equivalent full load hours (EFLH) for various residential and C&I HVAC measures. The Commission received some general comments regarding how the EFLH values in the TRM were developed and those comments will be addressed here.

* + - 1. **Comments**

PennFuture/KEEA states that nearly all of the energy savings for HVAC measures are determined based on the measures heating or cooling capacity and an estimate of EFLH. PennFuture/KEEA notes that the EDC and city-specific EFLHs for most HVAC measures were developed based on heating degree adjustments to EFLH estimates from another state. PennFuture/KEEA points out that the TRM does not give the base temperature for these HDD adjustments making it impossible to evaluate the reasonableness of the ELFH tables. PennFuture/KEEA recommends providing additional documentation regarding the EFLH data and degree day adjustments and how they were developed. PennFuture/KEEA also suggests that these measure savings be modeled.[[67]](#footnote-67)

* + - 1. **Disposition**

The Commission agrees with PennFuture/KEEA regarding the need for proper documentation supporting the EFLH values. The Commission would like to clarify that EFLH values for C&I HVAC measures are calculated based on the degree day scaling methodology to account for weather differences within Pennsylvania. The EFLH values reported in the 2012 Connecticut Program Savings Documentation were adjusted using full load hours (FLH) from the U.S. Department of Energy’s (U.S. DOE) ENERGY STAR Calculator.[[68]](#footnote-68) Degree day scaling ratios were calculated using HDD and CDD values for seven Pennsylvania cities: Allentown, Erie, Harrisburg, Philadelphia, Pittsburgh, Scranton, and Williamsport.

The Commission also acknowledges PennFuture/KEEA’s comments that the EFLH values for the C&I HVAC measures can be modeled. The Commission notes that the SWE is currently doing eQUEST modeling to update EFLH values for C&I HVAC measures; motor operating hours for the C&I motors measure and energy savings factors (ESF) and demand savings factors (DSF) for C&I VFD measure protocols for future TRM updates. The Commission points out that additional information regarding the SWE’s methodology and work completed thus far is described in the HVAC, motors and VFD measure-specific sections in this Final Order.

1. **Additional Residential EE&C Measure Protocols**

The Commission understands that the expansion of the residential section of the TRM is essential for the accurate and timely M&V of the EDCs’ Act 129 energy efficiency programs. This update to the TRM includes the addition of nine new residential EE&C measure protocols. The EDCs’ independent evaluators, in collaboration with the SWE, produced, reviewed and edited these new residential EE&C measure protocols. We received no comments on these measures and will adopt them. The following new residential EE&C measure protocols are included:

* Fuel Switching- Electric Water Heater to Oil and Propane Water Heaters;
* Fuel Switching- Heat Pump Water Heater to Oil and Propane Water Heaters;
* Fuel Switching- Electric Heat to Oil and Propane Heaters;
* Fuel Switching- Electric Water Heater to Gas, Oil, and Propane Tankless Water Heater;
* Fuel Switching- Heat Pump Water Heater to Gas, Oil and Propane Tankless Water Heater;
* Water Heater Temperature Setback;
* Compact Fluorescent Lighting (CFL) Specialty Bulbs;
* LED Specialty Bulbs; and,
* ENERGY STAR Water Coolers.

1. **Additional Commercial and Industrial EE&C Measure Protocols**

As with residential measures, expansion of the C&I section of the TRM is also essential for the M&V of the EDC EE&C programs. Based on collaborative discussions between the SWE and the EDCs and the available research, the following additional seven C&I EE&C measures and associated protocols are adopted:

* Fuel Switching- Electric Water Heater to Gas, Oil and Propane Water Heater;
* Fuel Switching- Heat Pump Water Heater to Gas, Oil and Propane Water Heater;
* Fuel Switching- Electric Water Heater to Gas, Oil and Propane Tankless Water Heater;
* Fuel Switching- Heat Pump Water Heater to Gas, Oil and Propane Tankless Water Heater;
* Fuel Switching- Electric Heat (Baseboard, Furnace, ASHP) to Gas, Oil and Propane Heaters;
* Floating Head Pressure Controls; and,
* Refrigeration VSD Compressor.

This Commission adopts the addition of the seven new C&I protocols noting the changes to certain measures, outlined below.

1. **Fuel Switching – Electric Water Heater to Gas, Oil and Propane Water Heater and Fuel Switching – Heat Pump Water Heater to Gas, Oil and Propane Water Heater**

In the Tentative Order, the Commission proposed the addition of a new Fuel Switching – Electric Water Heater to Gas, Oil and Propane Water Heater and Fuel Switching – Heat Pump Water Heater Electric to Gas, Oil and Propane Water Heater measure protocols. These protocols document the energy savings attributed to converting from a standard electric or heat pump water heater to a standard natural gas/propane-fired water heater.

* 1. **Comments**

PECO recommends expanding the measure (with appropriate sources for annual water use) to include larger commercial units in food service building types, such as restaurants that often use large quantities of hot water. Additionally, PECO suggests increasing the minimum energy factor for the fossil fuel units to ENERGY STAR standards, where they exist. PECO also proposes updating the Energy to Demand Factor using the provided water heater load profile in Figure 3-11 and the new peak period. PECO requests that a Multi-Family (Common Areas) or “Other” Building Type be added in Table 3-116 that would apply to several building types. PECO suggests updating the temperature of hot water (T hot) assumption to 123°F. Additionally, PECO recommends adding a minimum baseline energy factors table based on the tank size similar to Sections 3.28 and 3.29. It proposes renaming Section 3.38.4 to “Default Savings” as the measure has been adjusted to a partially deemed algorithm, as well as replacing the word “deemed” with “default.” PECO requests the removal of the deemed savings values and insertion of a deemed savings algorithm for ΔkWh. PECO states that this would reflect the revision of this measure to a default value for EF base and EF proposed rather than a deemed value, and also allows the default savings to be based on tank size. [[69]](#footnote-69)

Furthermore, PECO recommends updating the algorithms and terms with a derating factor of 0.91 for tankless water heaters to account for the difference between the rated and actual performance of these water heaters. PECO references the 2012 Illinois TRM and notes that the disconnect between rated energy factor and *in-situ* energy consumption is markedly different for tankless units due to significantly higher contributions to overall household hot water usage from short draws. PECO notes that the additional energy losses incurred by the surrounding space when the unit cools in-between shorter draws was found to be 9% in the *Field and Laboratory Testing of Tankless Gas Water Heater Performance* study prepared for Lawrence Berkeley National Laboratory by Davis Energy Group in 2006.[[70]](#footnote-70)

PennFuture/KEEA states that it is unclear why this measure is included given the support of heat pump water heaters and the associated measure characterization. In addition, PennFuture/KEEA notes that the characterization assumes a baseline replacement fossil fuel-fired water heater rather than an efficient version and promoting such a switch does not seem to have any value for the customer or society other than to promote first-year electric energy savings that would contribute to an EDC’s goal.[[71]](#footnote-71)

* 1. **Disposition**

The Commission has adopted PECO’s recommendations with a few exceptions. The Commission agrees with PECO’s recommendation to expand the measure to include larger commercial units in food service building types. However, we believe this task requires further review and direct the PEG to research this topic and provide recommendations for future TRM updates. The Commission notes that there are no ENERGY STAR standards available for oil-fired water heaters. The Commission, therefore, directs that the fuel consumption for oil-fired water heaters remain equivalent to the federal standard.

The Commission acknowledges PennFuture/KEEA’s comments that the measure characterization for heat pump water heaters measure assumes a baseline replacement fossil fuel-fired water heater rather than an efficient version. As noted above, the Commission has updated the efficient condition of the fossil fuel water heaters to reflect ENERGY STAR standards where possible. The rationale for this measure is that fuel switching from heat pump water heaters generates electric savings. This gives the EDCs an opportunity to provide electric savings to their customers and meet their savings goals. Measures in the TRM do not need to pass the TRC Test as individual measures, so long as an EDC’s program portfolio is cost-effective. While the Commission would not logically expect to see both fuel switching from heat pump measures, as well as heat pump rebates within an EDC’s portfolio, the Commission believes it is important to provide EDCs with the option to include either measure in their plans.

1. **Fuel Switching** – **Electric Heat (Baseboard, Furnace, ASHP) to Gas, Oil and Propane Heaters**

In the Tentative Order, the Commission proposed the addition of a new Fuel Switching – Commercial Electric Heat to Natural Gas, Oil and Propane Heat measure protocol. This protocol documents the energy savings of conversions from a standard electric primary heating source to an efficient natural gas/propane/oil furnace or boiler.

* 1. **Comments**

PECO states that, if this measure is intended for smaller commercial facilities where equipment is similar to residential equipment, eligibility for this measure should be limited to smaller systems. PECO references that 2012 Illinois TRM,[[72]](#footnote-72) which uses 225,000 kBtu as a cutoff for small furnaces and boilers. PECO notes that the default blower motor HP could be inappropriate for larger systems. PECO requests that, in addition to the most up to date ENERGY STAR requirement, older models that met a previous ENERGY STAR metric be acceptable with a sunset date. Additionally, PECO requests that appliances without an ENERGY STAR label but meeting current ENERGY STAR requirements be accepted. PECO also recommends allowing EDC’s to use billing analysis data to claim measure savings, in lieu of using the defaults provided.[[73]](#footnote-73)

* 1. **Disposition**

The Commission clarifies that the protocol is intended for smaller commercial facilities where equipment is similar to residential equipment. The Commission agrees with PECO’s recommendation to use 225,000 kBtu as a cutoff. The Commission also agrees with PECO that older ENERGY STAR units should be given a sunset date and has updated the TRM. Additionally, the Commission will allow the EDCs to provide incentives for equipment with efficiencies greater than or equal to the applicable ENERGY STAR requirement. Finally, the Commission accepts PECO’s suggestion to allow billing analysis data, when available, in lieu of the defaults provided in the TRM. The Commission, however, notes that billing analysis should be conducted using at least 12 months of billing data (pre- and post-retrofit).

1. **New Agricultural EE&C Measure Protocols**

The following eight agricultural measure protocols were proposed for inclusion in the 2014 TRM:

* Variable Speed Drives (VSDs) on Dairy Vacuum Pumps;
* Automatic Milker Take-offs;
* High Volume Low Speed (HLVS) Fans;
* Dairy Scroll Compressors;
* Low Pressure Irrigation Systems;
* Livestock Waterers;
* Heat Reclaimers; and,
* High Efficiency Ventilation Fans with and without Thermostats.

This Commission adopts the eight new agricultural protocols noting the changes to certain measures, outlined below.

* 1. **Variable Speed Drive Controller on Dairy Vacuum Pumps**

In the Tentative Order, the Commission proposed the addition of a new protocol for a variable speed drive (VSD) controller on dairy vacuum pumps.

* + - 1. **Comments**

PECO comments that the introduction should be modified as the range in electrical consumption depends on whether or not the vacuum pump is oversized. If a vacuum pump is not over-sized in comparison to the number of milking units being deployed, then the percentage of electrical consumption afforded to the vacuum pump will be significantly lower. PECO recommends additional eligibility requirements for VSDs.[[74]](#footnote-74)

PECO comments that the algorithm for peak demand reduction is incorrect. Currently, the algorithm includes the multiplying of energy savings by the CF. As the energy savings algorithm is using an ESF per cow, PECO recommends finding the equivalent factor for peak demand reduction. Another method would be to divide the energy savings by the annual vacuum pump run hours and then multiply by the CF. PECO recommends being making the TRM consistent in the definition of CF across all agricultural measures. A closer approximation would be the load shape for dairy farms utilized in the Vermont TRM (0.341). This value is an aggregate for all dairy farm equipment during the summer peak period and is more accurate than what is currently used. The source notes will need to be rewritten accordingly.[[75]](#footnote-75)

* + - 1. **Disposition**

The TRM has been amended to revise the language regarding energy consumption of dairy farms in the introduction as suggested by PECO. The Commission rejects PECO’s suggestion to include best practices for installation of VSDs because installation information is not necessary for TRM calculations or for evaluation purposes.

The TRM has not been amended to correct the Peak Demand Reduction in Subsection 4.7.2 because the CF in the assumptions incorporates that information. The Commission agrees with PECO’s recommendation to revise the CF in agricultural measures so that it is similar to the CF in the other sections of the TRM. The Commission, however, notes that this will require review of data and development of a new CF and Energy to Demand Factor, and directs the PEG to develop these new values for inclusion in the 2015 TRM update.

* 1. **Automatic Milker Take-offs**

In the Tentative Order, the Commission proposed the addition of a new protocol for automatic milker take-offs.

* + - 1. **Comments**

PECO comments that the vacuum pump VSD measure should be located prior to the automatic milker take-offs measure. The majority of the savings for the automatic milker take-off measure come from the installation of a VSD. VSDs are an integral part of automatic milker take-offs and are referenced extensively in the subsequent agricultural sections. PECO points out that, in the first source note, the calculation used for the ESC (energy savings per cow per year) needs to be referenced. Additionally, the source used for average vacuum pump HP actually does not specify an average HP. The source details the energy savings of a range of vacuum pumps but does not specifically mention that ten HP is the average HP. PECO comments that the references for sources 5 and 6 should be updated with a reference to the new vacuum pump measure protocol.[[76]](#footnote-76)

* + - 1. **Disposition**

The TRM has been updated to clarify source 1, as well as to include correct reference numbers, add clarification on motor HP and properly reference Section 4.7 as the reference for sources 5 and 6.

* 1. **Dairy Scroll Compressors**

In the Tentative Order, the Commission proposed the addition of a new protocol for daily scroll compressors. This TRM section estimates energy and demand savings for the installation of a scroll compressor to replace an existing reciprocating compressor or the installation of a scroll compressor in a new construction application.

* + - 1. **Comments**

PECO recommends some language changes to this measure. PECO comments that the definition of the compressor operating hours does not accurately reflect the operating hours of the compressor. The “HRS” component used in the algorithm should be the EFLH of the compressor. This means a different default value for hours should be used along with a revised source/explanation. PECO further comments that Table 4-2 calls for nameplate energy efficiency ratios (EER) to be collected in order to calculate savings. In order to collect valid EER information for compressors, EER data must be collected from compressor manufacturer information at a given operating condition. PECO comments that, in the third source note, milk delta T is defined as “…between cow temperature milk and cooled milk.” PECO recommends elaborating as follows, “…delta T is the difference between the temperature of the milk as it leaves the cow and the target temperature to which the milk is cooled.”[[77]](#footnote-77)

* + - 1. **Disposition**

The TRM has been amended to revise the language regarding energy consumption of dairy farms, to correct the definition of Compressor Operating Hours, to add language to Subsection 4.2.4 regarding collecting EER data and to elaborate on the Milk Delta T definition, as well as to correct minor grammatical errors. The Commission rejects PECO’s suggestion to include only bulk tank cooling in the language because alternate in-line cooling methods are possible.

* 1. **Low Pressure Irrigation Systems**

In the Tentative Order, the Commission proposed the addition of a new protocol for low pressure irrigation system. This protocol estimates energy and demand savings for the installation of a low-pressure irrigation system.

* + - 1. **Comments**

PECO recommends that the eligibility requirements be updated to account for alterations or retrofits to the pumping plant. PECO comments that a definition for the constant 1,714 should be added to the definition of terms. PECO comments that the five year measure life is inaccurate. Typically, the five years will refer to the nozzles, which do in fact need to be replaced every five years. Drip irrigation systems can last upwards of 25 years, but may require routine maintenance every few years. PPL suggests that the OPHRS variable (average irrigation hours per growing season) be included in Table 4-13 with all other variables.[[78]](#footnote-78)

* + - 1. **Disposition**

The TRM has been amended to include alterations or retrofits to the pumping plant to the eligibility Subsection 4.8.1 as well as to define the constant 1,714 in Subsection 4.8.3. The TRM has been amended to include the OPHRS variable in Table 4-13. The TRM, however, has not been amended to increase the measure life in Section 4.8.5. The Commission directs the PEG to determine if it is necessary to change the effective life of this section or prepare additional measures to account for variations in measure life and provide recommendations during future TRM updates.

* 1. **Livestock Waterers**

In the Tentative Order, the Commission proposed the addition of a new protocol for livestock waterer.

* + - 1. **Comments**

PECO suggests rewording the introduction to include a comment that insulated containers keep the water from freezing with the use of a buoyant ball that livestock use to agitate the water. PECO recommends including in the Eligibility Requirements an option for energy-free livestock waterers as a viable replacement. Energy-free livestock waterers do not have heating elements, resulting in zero watts, or utilize a back-up heating element that is no larger than 50 watts. PECO proposes allowing users to input base wattages and efficient wattages of the existing and proposed units, instead of a default/deemed ESW factor (energy demand savings per waterer). If the base and efficient wattages are unknown, PECO recommends using the existing default value of 0.5 kW. This lets the user be more flexible with the size of the units being assessed, as well as increasing the energy savings if energy-free units are to be evaluated.[[79]](#footnote-79)

* + - 1. **Disposition**

The Commission rejects the suggested change to the introduction because it is too limiting to the technologies as there are alternate options to the buoyant ball approach. The TRM currently covers both low energy and zero energy waterers and assumes an average wattage reduction as stated in 4.6. The Commission directs the PEG to determine if an energy free waterer and energy efficient waterer should be included as separate measures and provide recommendations during future TRM updates.

* 1. **Heat Reclaimers**

In the Tentative Order, the Commission proposed the addition of a new protocol for heat reclaimers.

* + - 1. **Comments**

PECO comments that the second source note mentions an assumed cow production of 6.5 gallons of milk per day. The correct value, which is accurately mentioned in the dairy scroll compressor section, is 6 gallons of milk per day. PECO comments that the Default Value for Cows should be included in the Table for the Variables for Heat Reclaimers. PECO also comments that, in the third source note, milk delta T is defined as “…between cow temperature milk and cooled milk.” PECO recommends elaborating as follows, “…delta T is the difference between the temperature of the milk as it leaves the cow and the target temperature to which the milk is cooled.”[[80]](#footnote-80)

PECO and PPL comment that, in the introduction, the measure life is 15 years but in the measure life section it is 14 years. The value of measure life should be changed from 14 years to 15 years in the measure life section.[[81]](#footnote-81)

* + - 1. **Disposition**

The TRM has been amended to correct the assumed milk production in Subsection 4.4.4. Additionally, we have added the default value for cows in the Table for the Variables for Heat Reclaimers in Subsection 4.4.4, as well as elaborated on the Milk Delta T definition. Lastly, the measure life has been amended to the appropriate value of 15 years in the Measure Life Section 4.4.5.

* 1. **High Efficiency Ventilation Fans with and without Thermostats**

In the Tentative Order, the Commission proposed the addition of a new protocol for high efficiency ventilation fans with and without thermostats.

* + - 1. **Comments**

PECO believes that it is important to include a warning that farmers should not exceed or fall short of the recommended airflow ratings for their animals. It may also be important to include a warning on replacing pit fans for swine facilities and that maintaining airflow recommendations with these fans are critical for the health of the hogs. PECO comments that the CFM (cubic feet per minute of air movement) definition should include the caveat that this value is to be at a static pressure of 0.1 inches water, similar to what is included on the definitions of the fan efficiency and baseline terms. PECO also comments that Table 4-2 calls for nameplate EER, but in order to collect valid EER information for compressors, EER data must be collected from compressor manufacturer information at a given operating condition.[[82]](#footnote-82)

* + - 1. **Disposition**

The Commission rejects PECO’s recommendation to include a warning in the measure description about not exceeding or falling short of airflow ratings because it is not relevant to the energy savings technical requirements, but rather an operating best practice. The TRM has been amended to add the caveat that the CFM value should be at a static pressure of 0.1 inches of water in Subsection 4.3.3. Additionally, the TRM has been amended to add language to 4.3.4 regarding collecting EER data from manufacturers at given operating conditions.

1. **Existing Residential EE&C Measure Protocols and Processes**
2. **Electric HVAC Protocols**
3. **Equivalent Full Load Hours**

In the 2013 TRM update, the Commission directed the PEG to consider a suggested modification to the methodology used for EFLH estimation based on the concern that the current methodology weights home characteristics across the state rather than for cities specific to each EDC.[[83]](#footnote-83) In the Tentative Order, the Commission proposed to revise the methodology to include cooling EFLH and heating EFLH tables showing EFLH data for each EDC. These tables may be used in place of the default weighted values[[84]](#footnote-84) currently in the protocol if they are more appropriate.

These proposed new and more detailed EFLH tables would affect the following sections of the 2013 TRM: Section 2.1 – Electric HVAC, Section 2.5 – Furnace Whistle, Section 2.11 – Programmable Thermostat, Section 2.17 – Ductless Mini-Split Heat Pumps, Section 2.20 – Fuel Switching: Electric Heat to Gas Heat and Section 2.21 – Ceiling/Attic and Wall Insulation.

With regard to Section 2.20 – Fuel Switching: Electric Heat to Gas Heat, heating EFLH tables were also created for various types of heating systems. In addition to the heating EFLH based on air source heat pumps (ASHPs) determined in Section 2.1 – Electric HVAC, heating EFLH was calculated for electric forced-air furnaces, electric baseboard heating and natural gas furnaces. These additional heating EFLH tables were calculated using the same methodology and modeling utilized to determine the 2013 weighted average heating EFLH, and follow the same format and appearance as the revised EFLH tables presented in Section 2.1 – Electric HVAC.

1. **Comments**

PPL requests that the Commission add PPL-specific EFLH for Williamsport and Philadelphia in Tables 2-2 and 2-3 since PPL has customers with zip codes that map to those cities. In addition, PPL recommends that the Commission add EDC data gathering as an option for HSPFm in Table 2-1 to ensure consistency with other variables.[[85]](#footnote-85)

1. **Disposition**

The Commission agrees with PPL’s suggestion to add PPL-specific EFLH for Williamsport and Philadelphia. Given that this would require additional data review and development of new EFLHs, the Commission directs the PEG to develop these EFLH values for inclusion in Table 2-2 and 2-3 as part of future TRM updates. The Commission also directs the PEG to consider adding EDC data gathering as an option for HSPFm in Table 2-1 in subsequent TRM updates.

1. **Duct Sealing**

In the 2013 TRM Final Order, the Commission directed the PEG to review the Duct Sealing methodology and provide recommendations for future TRM updates based on concerns of overstating of savings.[[86]](#footnote-86) In the Tentative Order, based on a review of the 2013 Mid-Atlantic TRM[[87]](#footnote-87) and the 2013 Illinois Statewide TRM,[[88]](#footnote-88) the Commission proposed to remove the duct sealing measure from the Electric HVAC protocol and develop a new protocol specifically for duct sealing in the 2014 TRM.

1. **Comments**

PECO recommends that the Central Air Conditioning (A/C) and Air Source Heat Pump (ASHP) (Duct Sealing) measure be removed from Section 2.1 since it has been replaced by measure 2.41 Duct Sealing and Insulation.[[89]](#footnote-89)

1. **Disposition**

The Commission agrees with PECO’s comment regarding the removal of the measure from Section 2.1. The TRM has been updated accordingly.

1. **Central Air Conditioning and Air Source Heat Pump Maintenance**

In the 2013 TRM Final Order, the Commission directed the PEG to review the central A/C and ASHP maintenance savings factor based on concerns of overstating of savings and provide recommendations for future TRM updates.[[90]](#footnote-90) In the Tentative Order, based on a review of the 2013 Illinois Statewide TRM, the Commission proposed to update the maintenance factors for central air conditioners and ASHPs from 10% to 5%.

1. **Comments**

PECO requests that the Commission add information about the conditions that must be met to be able to claim stipulated savings for each measure, consistent with other protocols. PECO also requests that the Commission specify if the Proper Sizing measure is specifically for new units.[[91]](#footnote-91)

1. **Disposition**

The Commission agrees with PECO’s comment regarding the need for clarifying information on conditions to be met to claim stipulated savings and has provided such language in the TRM.

1. **Ground Source Heat Pumps and Desuperheaters**

In the 2013 TRM Final Order, the Commission directed the PEG to determine possible methods of adjusting the Air-Conditioning, Heating and Refrigeration Institute (AHRI) ratings due to the fact that AHRI ratings do not account for energy consumed by auxiliary water loop pumps. The Commission also directed the PEG to review the assumed savings per desuperheater because of concerns that savings are overstated and provide recommendations for future TRM updates.[[92]](#footnote-92)

In order to address the impact of the auxiliary water loop pump on system performance, the Commission proposed to add a de-rate factor in order to calculate a system heating coefficient of performance (COP) and system cooling EER from the heat pump rated COP and EER. The de-rate factor is determined as 100% minus the estimated percentage of system energy attributed to the loop pump based on heat pump design guidelines[[93]](#footnote-93) and a typical single family home heat pump system size. In addition, the desuperheater methodology will be revised to include an algorithm to calculate desuperheater savings by applying a desuperheater savings factor to the algorithm for calculating total annual hot water use from Section 2.3.2 of the 2013 TRM. The desuperheater savings factor was estimated based on a review of recent studies of desuperheaters.[[94]](#footnote-94) The new algorithm results in significantly reduced desuperheater savings – from 1,842 kWh to 576 kWh and from 0.34 kW to 0.05 kW.

1. **Comments**

PennFuture/KEEA comments that rated efficiencies between ASHP and ground source heat pumps (GSHP) are not fully comparable and that GSHP metrics typically overstate efficiency because they do not include pumping energy. PennFuture/KEEA recommends that any GSHP COPs and EERs be adjusted using the RESNET consensus standard. PennFuture/KEEA also comments that 1,842 kWh savings for desuperheaters is much too high and cite sources that suggest that the average savings is 342 kWh.[[95]](#footnote-95)

PECO comments that it is not clear if the CF represents the CF for the new peak demand period, as it has not been adjusted from when the 100 hour proxy period was being used. PECO recommends that this CF and the Energy to Demand Factor be revised using an HVAC profile in Pennsylvania and the new peak period. PennFuture/KEEA comments that it is necessary to justify why the reference cited for using a 70% CF for cooling measures is relevant to Pennsylvania, given the significant effect of local weather conditions and equipment sizing practices.[[96]](#footnote-96)

1. **Disposition**

The Commission notes that the TRM has been updated to include a de-rated GSHP efficiency that considers pumping energy. The Commission directs the PEG to research other information and standards for de-rating GSHP efficiency for consideration as part of future TRM updates. The Commission notes that the TRM has been updated to include a reduced default savings value of 576 kWh. The Commission directs the PEG to research the cited sources, as well as additional sources, to determine if any further adjustment is needed for future TRM updates.

The Commission agrees with PECO’s recommendation to revise CF and the Energy to Demand Factor using and HVAC profile in PA and the new peak period. However, given that this will require review of data and development of a new CF and Energy to Demand Factor, the Commission directs the PEG to develop these new values for inclusion in the subsequent TRM updates. The Commission also agrees with PennFuture/KEEA’s comment that it is necessary to evaluate the validity of the existing source and consider additional sources. Again, given that this will require review and additional research, the Commission directs the PEG to review the existing source and complete additional research on the topic as part of future TRM updates.

1. **Central AC (Proper Sizing)**

The Central A/C (Proper Sizing) measure protocol was not discussed in the Tentative Order. We did, however, receive comments on this topic and will address those comments here.

1. **Comments**

PennFuture/KEEA comments that while demand savings for proper sizing of central A/C may be expected, energy savings, even at 5%, are less certain and possibly overstated.[[97]](#footnote-97)

1. **Disposition**

The Commission agrees with PennFuture/KEEA’s concern regarding energy savings for proper sizing being less certain and possibly overstated and requires further investigation. As such, we direct the PEG to investigate the issue further and provide recommendations during future TRM updates.

1. **Revisions to HVAC Algorithms**

The savings algorithms for the Electric HVAC measure protocol was not discussed in the Tentative Order. We did, however, receive comments on this topic and will address those comments here.

1. **Comments**

PennFuture/KEEA believes that there is wide variation in sizing practices by HVAC contractors. The tendency is for contractors to oversize units which will typically overstate savings given the proposed HVAC measure algorithms. PennFuture/KEEA notes that HVAC-rated heating capacities are based on an outside temperature of 47°. PennFuture/KEEA believes that most heat pump operations will be at lower temperature bins where the capacity rating and energy efficiency will be less. Further, the heat pump efficiency metric (heating seasonal performance factor (HSPF)) fails to consider the typical need for supplementary heat to meet a home’s full heating needs.[[98]](#footnote-98)

Additionally, PennFuture/KEEA states that, while most heat pumps will have reduced outputs and operate at lower efficiencies when operating below their rated capacity at 47°, a growing number of cold climate heat pumps, particularly ductless split units, maintain their rated capacity at or below 0°. PennFuture and KEEA recommend revising all of the heat pump characterizations to address actual heat pump output given Pennsylvania weather conditions, degree day distributions and the need for supplementary heat.[[99]](#footnote-99)

1. **Disposition**

The Commission believes the comments provided by PennFuture/KEEA may have merit. As such, the Commission directs the PEG to review the comments from PennFuture/KEEA relating to the savings protocols for HVAC equipment and provide recommendations for future TRM updates.

1. **ENERGY STAR Lighting**
2. **Introduction and Organization**
3. **Comments**

PECO recommends that the protocols for ENERGY STAR Lighting and ENERGY STAR LED measures be combined into one common protocol. PECO notes that these two measures have been combined into a single ENERGY STAR lamp specification.

PECO also recommends a number of clarifications and organization changes, including the addition of: 1) additional descriptors to the types of bulbs and fixtures impacted by the protocol; 2) a definition of “efficient equipment;” and, 3) a definition of “baseline equipment.” PECO also suggests adding a subsection heading “2.29.4 Default Savings” after Table 2-76 and adding language to allow direct install programs to use the wattage of the replaced bulb as the baseline wattage. Regarding savings for CFL and LED measures, PECO states that it intends to base PY5 verified savings on the updated 2014 TRM protocol.[[100]](#footnote-100)

PECO recommends adding in language concerning out-of-territory sales (leakage), which it believes should be assumed to be zero based on the U.S. DOE’s Uniform Methods Project (U.S. DOE UMP)[[101]](#footnote-101) and the notion that leakage out is likely approximately offset by leakage in. Additionally, PECO suggests updating the fixture savings default tables (Table 2-77 and 2-78) to account for updated CF and interactive effect (IE) values, and adding in defaults for a range of fixture bulb combinations. PECO states that it may be beneficial to replace these tables with Wattsee and Wattsbase values to allow the EDCs to calculate specific values based on custom inputs.[[102]](#footnote-102)

PennFuture/KEEA comments that the protocol was unclear as to how the Energy Independence and Security Act of 2007 (EISA)[[103]](#footnote-103) legislation and some of the footnotes were used in the lamp-specific savings estimates.[[104]](#footnote-104)

1. **Disposition**

The Commission agrees with PECO’s suggestions to combine the ENERGY STAR Lighting and LED protocols into a single, comprehensive protocol. This will streamline the savings estimation process for lighting measures. The Commission also accepts the inclusion of language regarding out of territory bulb sales.

While The Commission has provided clarifying language in the measure protocol, we did not add “immediately” to describe the In Service Rate (ISR) definition. The ISR in this document is used to estimate bulbs that are installed within three years of installation, not just the bulbs that are installed immediately. We also added language that direct install programs may use the wattage of the removed lamp as a baseline, but only when the lamp is removed by the contractor and the wattage is known. Direct install programs where contractors leave bulbs for future installation do not apply to this exception.

The Commission rejects PECO assertion that it base its PY5 verified savings for CFL and LED measures on the 2014 TRM protocol. This TRM update is not effective until June 1, 2014, and is to be applied on a prospective basis. The Commission acknowledges PECO’s suggestions regarding Fixture Tables 2-77 and 2-78 and has decided to remove default savings values in response. The Commission agrees with PECO’s comment on the large variety of fixture bulb combinations and directs the EDCs to calculate fixture savings on an individual fixture basis, using applicable numbers and wattages of bulbs present in each fixture and TRM specific fixture inputs. The Commission notes PennFuture/KEEA’s concerns over how EISA and other documents were used to develop lamp-specific estimates and have added clarifying language where requested in other sections of the protocol.

1. **General Corrections**
2. **Comments**

PECO and PPL comment that the ceiling fan protocol had an error in the calculation of interactive effects. The algorithm (1-IEkWh) and (1-IEkW) should be corrected to (1+IEkWh) and (1+IEkW). PECO and PPL also comment that the IE factor was missing in the LED algorithm and that the source is mislabeled in Table 2-86.[[105]](#footnote-105)

PECO requests that the “/1000” conversion from watts to kW be included following the delta watts section in all algorithms and that the HoursLED input be changed to LEDhours. PECO further comments that the definition of Wattbase in the ENERGY STAR Lighting protocol lists the wrong table and requests corrections to reference Table 2-74 and 2-75. PECO requests that the ENERGY STAR LED protocol update the source to include both Tables 2-87 and 2-88. PPL and PECO note that the source for IE in Table 2-73 and Table 2-86 is incorrect.[[106]](#footnote-106)

1. **Disposition**

The Commission accepts the changes proposed by PECO and PPL.

1. **Coincidence Factor**

In the 2013 TRM Final Order, the Commission directed the PEG to research the CF utilized in the Residential ENERGY STAR Lighting protocol and provide recommendations for future TRM updates.[[107]](#footnote-107) The Commission reviewed a number of metering studies and determined that the residential lighting CF of 9.1% from the most recent study from EmPOWER Maryland was the most appropriate study to use.[[108]](#footnote-108) The study includes a CF based on the PJM definition of peak, with a precision of ±3% at the 90% confidence level. In addition, the 129 metered homes in Maryland have geographic attributes, weather and other factors that are similar to Pennsylvania.

1. **Comments**

PECO comments that it is unclear whether the 9.1% represents the new peak demand period or the old peak period and requests clarification on this point. PECO requests that the CF be clearly identified as a “default” value rather than a “deemed” value and “or EDC Data Gathering” should be added to the Value cell in Table 2-73 to allow EDC-specific CFs to be developed. PECO notes that it has determined its own territory-specific CF of 11.6% for the Phase II peak demand period, based on an analysis of various residential lighting load shapes from different studies.[[109]](#footnote-109)

FirstEnergy comments that the values for CF and HOU come from different sources. The CF comes from an EmPOWER Maryland metering study, while the CFL/LED HOU are from a Nexus Market Research study performed for four states in New England. FirstEnergy requests a consistent source for both CF and CFL hours.[[110]](#footnote-110)

1. **Disposition**

The Commission clarifies that the 9.1% peak CF represents the new (PJM) peak demand period. Because the SWE is currently conducting a large lighting metering study[[111]](#footnote-111) to update the CF and HOU estimates in future TRM updates, the Commission rejects the request to allow EDC data gathering in the CF value and will not change the value to “default” rather than “deemed.” The Commission has researched the referenced metering studies and does not believe that the studies cited by commenters are more representative of Pennsylvania’s geography, weather and demographic features than the information provided in the EmPOWER Maryland metering study.

The Commission acknowledges FirstEnergy’s request for consistent sources. Until the SWE’s metering study is completed, the Commission will maintain the current HOU value. The forthcoming light metering study will provide a consistent, Pennsylvania-specific source for these values, and the Commission anticipates the use of such information in future TRM updates.

1. **Baseline Wattage for General Service Lamps vs. Reflectors**

In the 2013 TRM Final Order, the Commission directed the PEG to develop applicable and appropriate support for the sources for baseline wattages and to consider the possibility of differentiating lumen bins for directional versus non-directional bulbs.[[112]](#footnote-112) After the SWE’s review of various sources of general service and reflector baseline wattages, the Commission proposed to include separate default values for general service and reflector bulbs. The general service lamp baseline should be consistent with the 2013 TRM, matching the EISA requirements. The reflector lamp default values should be based on manufacturer available products. Because the provided reflector baselines may not encompass all technologies, lumens and wattages on the market and because the manufacturer may be issuing new products during the course of the year, the Commission proposed that the EDCs be given the option of using the manufacturer-rated equivalent baseline wattage, as noted on the retail bulb package.

1. **Comments**

PennFuture/KEEA comments that there is strong evidence of stock carry-over past the EISA standard implementation dates. It recommends revising the baseline for 2014 lamps to account for this sell-through period.[[113]](#footnote-113) FirstEnergy agrees that there is a significant sell-through period for these bulbs, but notes that the June 1 TRM effective date addresses this issue. This effective date allows a five month sell-through period between the EISA implementation date and the implementation of the TRMs. FirstEnergy asserts that the baselines should be based on specific market research and market shelving studies.[[114]](#footnote-114)

PennFuture/KEEA asks if the baseline wattages for all EISA lamps fall into one of the assigned lumen bin categories in Tables 2-74 and 2-87, and recommends assigning a “wattage savings factor” to the lamp installed in lieu of the lumen to baseline wattage Tables in the TRM. Additionally, PennFuture/KEEA requests clarification on how bulbs of less than 310 lumens should be addressed in the savings calculations and questions whether all of the EISA-exempt bulb types are present in Table 2-75. PennFuture/KEEA also request clarity on the default values for fixtures and questions how the 3.95 CFL-to-incandescent wattage ratio referenced in footnote 161 is applied. Specifically, PennFuture/KEEA questions whether the ratio is EISA-adjusted and declining in each year.[[115]](#footnote-115)

PECO and PennFuture/KEEA request additional granularity in the baseline wattage categories.[[116]](#footnote-116) PECO asserts that there are multiple wattage ranges for each type of specialty bulb; however, Table 2-75 assumes a single baseline wattage. PECO submits a different baseline wattage table and recommends updating the protocol to reference the ENERGY STAR 1.0 lamp specification. PECO also comments that the directions to determine Wattsbase are confusing. Finally, PECO recommends adding a few sentences to introduce the delta watts tables or move Table 2-74 and 2-87 to below the text describing the protocol for determining baseline wattage.[[117]](#footnote-117) PennFuture/KEEA supports PECO’s approach, but requests that the SWE review the PECO-proposed baseline wattages to confirm that they are technically correct and properly aligned.[[118]](#footnote-118)

PPL and PECO request adding language to this protocol allowing the use of existing (removed) lamp wattage in direct install programs when the removed lamp wattage is known. PECO requests that language be inserted into the value cell for Wattsbase for direct install programs. PPL also recommends adding guidance to allow the use of manufacturer-rated wattages for determining the baseline for a bulb that is not general service and is not on the U.S. DOE’s list.[[119]](#footnote-119)

PennFuture/KEEA comments that the baseline wattages provided do not adjust for the 2020 EISA 45-lumen per watt backstop standard. It recommends reducing post-2020 savings and/or measure life estimates for all EISA-compliant CFLs and LEDs, including fixtures that use such EISA compliant lamps, to account for this standard.[[120]](#footnote-120)

1. **Disposition**

The Commission acknowledges PennFuture/KEEA’s concern regarding a sell-through period following EISA implementation dates. However, the Commission agrees with FirstEnergy’s comments that the TRM allows for a five-month sell-through period between EISA implementation and the effective date of the TRM. Therefore, the Commission rejects PennFuture/KEEA’s recommendation to revise the 2014 baseline to adjust for this sell-through period.

The Commission also rejects PennFuture/KEEA’s request to create and apply a wattage savings factor to calculate baseline wattage as the savings factor varies significantly by lumen bin category and would not take the EISA standards into account. In response to PennFuture/KEEA’s question regarding bulbs less than 310 lumens, the TRM has been updated to clarify that any bulbs outside the lumen bins presented are exempt from EISA standards and should use the manufacturer-rated incandescent equivalent wattage. All EISA baseline wattages are included in the lumen bin categories present in Tables 2-74 and 2-87. Additionally, Table 2-75 includes common reflector and flood shaped bulbs, which are EISA-exempt bulbs. Reflector and flood lamps are subject to different standards and efficacy requirements from general service lamps and, therefore, have different baseline wattages.

In response to PennFuture/KEEA’s request for clarity on the fixture default values and based on PECO’s comments regarding the variability of incented fixture types, the Commission has removed these default fixture savings values from the TRM. Fixture savings calculations should now be completed on an individual fixture basis.

The Commission acknowledges the request from PECO and PennFuture/KEEA for additional granularity for the Wattsbase lumen bins, but rejects the replacement table provided by PECO. PECO’s table does not adhere to EISA maximum allowable wattage and overestimates the baseline wattages for all lumen categories. However, the Commission has updated the Baseline Wattage by Lumen tables to reflect the ENERGY STAR 1.0 Lamp specifications recommended equivalent incandescent wattage lumen bins. These new lumen bins are representative of the ENERGY STAR labeling requirement for ENERGY STAR labeled bulbs; however, the baseline wattages are reflective of the maximum allowable wattages post-EISA phase-in. For example, a general service ENERGY STAR CFL with 1200 lumens should be labeled as comparable to a 75-watt incandescent. However, according to EISA standards, incandescent bulbs with 1200 lumens cannot exceed 53 watts. Therefore, a 1200 lumen bulb has baseline wattage of 53 watts according to the new TRM table. As with the general service bulbs, the reflector and flood lamp baseline wattage table submitted by PECO does not represent the federal lighting standards for these bulbs and is, therefore, rejected.

The Commission accepts PPL’s request to allow the wattage of removed bulbs to be used in place of default Wattsbase for direct install programs where the wattage of the removed bulb is known. PECO’s request that the Wattbase value be changed to reflect the exception for direct install programs is reflected with an additional row in the Baseline Wattage lookup table. The Commission has added language that direct install programs may use the wattage of the removed lamp as a baseline, but only when the lamp is removed by the contractor and the wattage is known. Direct install programs where contractors leave bulbs for future installation do not apply to this exception. Additionally, the Commission accepts PPL’s request to clarify that manufacturer-rated wattages may be used for EISA-exempt bulbs.

Regarding PennFuture/KEEA’s comment that the baseline wattages provided do not adjust for the 2020 EISA 45 lumen per watt backstop standard, the Commission has added a column providing post-2020 baseline wattages to be used for cost-effectiveness calculations for lighting measures that have an expected useful life that extends beyond 2020.

1. **HVAC Interactive Effects**

In the 2013 TRM Final Order, the Commission directed the PEG to investigate and evaluate residential lighting-HVAC interactive effects for consideration in future TRM updates.[[121]](#footnote-121)  The SWE has reviewed the inclusion of an HVAC interactive effect and the potential calculation of the impact HVAC interactive effects present with residential lighting installations resulting from EDC program installations. The SWE constructed building energy models to determine the HVAC impacts from efficient lighting installations in the EDCs’ service territories. The SWE used these models to calculate energy and demand HVAC interaction factors, which are used to adjust the program lighting savings to account for the reduced waste heat. The EDC-specific interactive effect values reflect the unique climates, housing types and HVAC equipment saturations present in each service territory. In the Tentative Order, the Commission proposed the inclusion of an HVAC interactive effect input to the existing efficient lighting savings algorithms and the inclusion of the EDC-specific HVAC interactive effect values for savings calculations.

1. **Comments**

PECO requests that the IE for both CFLs and LEDs be updated with PECO-specific IE values based on an analysis completed by Navigant for PECO’s PY4 evaluation. Navigant has completed analysis using the BEopt computer simulation program coupled with the EnergyPlus simulation engine to develop PECO-specific IEkWh and IEkW based data gathered from PECO’s baseline study and billing data. PECO also requests an additional clarification in Tables 2-73 and 2-86 to specify that this value can be a custom value based on EDC data gathering.[[122]](#footnote-122)

FirstEnergy asserts that the IEs were neither supported nor thoroughly vetted through the PEG forum. Of particular concern was the applicability or use of REM/Rate modeling in estimating demand impacts. FirstEnergy recommends either: a) amending the reference to “EDC data gathering” in Table 2-73 to “EDC data gathering and analysis” and deleting Table 2-76 in its entirety; or b) revising the sentence preceding Table 2-73 “In the absence of EDC data gathering” to “In the absence of EDC data gathering and analysis.”[[123]](#footnote-123) PennFuture/KEEA comments that the IE values “seem high” and vary by a factor of three across EDCs.[[124]](#footnote-124)

1. **Disposition**

The Commission agrees that the PECO-specific CFL IE values can be used as the EDCs have the option of using evaluated values for this input. The Commission rejects the request to include this value as an LED IE value as the analysis did not model the IEs for LED bulbs, only CFLs. The Commission has calculated LED-specific IE factors and has listed them as default values in the TRM. It should be noted that the EDCs also have the option of using EDC-evaluated values for LED specific IEs. The Commission accepts PECO’s request to change the language of the IE cell in Tables 2-73 and 2-86 to reflect that this value allow “data gathering or the default values in the [appropriate] table.”

The Commission rejects FirstEnergy’s request to remove Table 2-76 in its entirety and to replace the cell reference to “EDC data gathering” in Table 2-73 to “EDC data gathering and analysis.” As noted in the TRM, the EDCs have the option to use EDC-specific data for this input when supported by an evaluation. However, the Commission would like to provide default values as an option. The Commission accepts FirstEnergy’s request to revise the sentence prior to Table 2-76[[125]](#footnote-125) to read “In the absence of EDC data gathering and analysis.”

The Commission recognizes the concerns of PennFuture/KEEA on the IE values and directs the PEG to review the comments on this issue and provide recommendations for future TRM updates.

1. **In-Service Rate**

In the 2013 TRM Final Order, the Commission directed the PEG to research possible definitions for ISR and to provide recommendations for future TRM updates.[[126]](#footnote-126) The ENERGY STAR Lighting Protocol defines the ISR as a factor used to reflect that not all lighting products purchased are actually installed. The Commission proposed the use of this definition in the 2014 TRM.

The 2013 TRM utilized an ISR based on a 2004 New England study, which was based on bulbs actually installed or planned to be installed within a year.[[127]](#footnote-127) However, following the 2013 TRM update, the SWE examined various jurisdictions’ ISRs in more detail. The SWE believes that it is appropriate to model an ISR trajectory and include savings for all program bulbs that are believed to ultimately be installed. Evaluations of the PECO Smart Lighting Discounts Program determined a first-year ISR of 78% for customers that purchased a bulb through a retailer or were provided a CFL through a give-a-way program. For future installations, the Commission believes that the recommendations of the U.S. DOE UMP be incorporated. The U.S. DOE UMP recommends using the findings from the evaluation of the 2006-2008 California Residential Upstream Lighting Programs, which estimated that 99% of program bulbs get installed within three years, including the program year.

Future installations can be handled in one of two ways: (1) by discounting future savings; or, (2) by staggering the timing of future savings claims. Due to the complexity of the staggering methods and disconnect between program expenditures and program savings, the Commission proposed discounting future savings to the program year in which the expenditures take place.

1. **Comments**

PECO requests clarification on the discount rate used to discount future savings back to the present year. PECO disagrees with the TRM’s discounting of future savings back to the present year and recommends utilizing an ISRCFL value of 99% to represent that only 1% of bulbs do not eventually get installed. PECO comments that the ISRCFL value in Table 2-73 does not match the corresponding footnote. PECO requests a separate ISR for direct install programs as they assert this rate may be different. PECO also requests that all deemed values, primarily IE and CF, be updated to allow evaluated values. PECO recommends updating the ISRLED to the ISRCFL value, given that the protocol applies future installations to the recommended ISR value, this should also be applied to LEDs, given their significant expense. [[128]](#footnote-128)

PPL recommends allowing the ISRCFL value in Table 2-73 be used as a default value for all ENERGY STAR Lighting ISRs as the EDCs generally do not know the specific customers who purchased the discounted bulbs through upstream programs and therefore do not know the type of fixture in which the CFL is installed.[[129]](#footnote-129)

1. **Disposition**

The Commission clarifies that a discount rate of .0757 was used to discount savings back to the present year. This rate is a weighted average of the nominal discount rates[[130]](#footnote-130) from each of the seven EDCs, as provided in the SWE’s Market Potential Study.[[131]](#footnote-131)

The Commission rejects PECO’s recommendation to not discount savings of future installations back to the present year and to change the ISRCFL to 99%. As mentioned previously, there were two options considered for claiming future installations of program bulbs: 1) account for future installations in the program year they are installed or, 2) claim them all in the program year, but discount the savings back to the present year. The SWE believed that the second option was preferable. Accounting for all the installed program bulbs in the current program year will greatly facilitate the cost-effectiveness test calculations and will not require a disconnect between the timing for the claimed savings and the administration and incentive costs.

The Commission accepts PECO’s recommendation to allow a separate ISR for CFL and LED direct install programs when supported by evaluation. However, the Commission rejects PECO’s request to allow evaluated values for all deemed values in Table 2-76 for the reasons stated in Section 2.c.ii. The Commission accepts PECO’s recommendation to update the ISRLED to the ISRCFL value. While the Commission agrees that further research is needed on the subject, the ISRLED value should be greater than or equal to the ISRCFL value given the large incremental cost of this measure. Additionally, the Commission directs the PEG to continue discussion on this topic and provide recommendations for future TRM updates.

In response to PPL’s request to apply the ISRCFL for all fixture types, the Commission would like to clarify the distinction between the ISRCFL and the ISRTorch, ISRIF, ISROF, and ISRFAN. While the ISRCFL applies to the individual CFLs incented by an EDC program, fixture specific ISRs (and other inputs) should be used when the incented product is a fixture. Stated otherwise, the fixture inputs are not reflecting the type of fixture where an incented CFL is installed, but of the type of fixture that is incented in an EDC program. Therefore, the Commission rejects the request to apply ISRCFL for all fixture types, as the installation rates for CFLs and fixtures are different.

1. **Lighting Installed in Commercial Settings**

As noted above, the incentive structure of upstream lighting programs does not allow for assurances that each purchaser of a program bulb is a residential customer in the sponsoring EDC’s service territory. As such, some program bulbs may be purchased by commercial customers and have different HOU, peak coincidence and ISRs than bulbs sold to residential customers.

The SWE and the Commission believe that the commercial TRM values for HOU and CF should be used for bulbs that are estimated to have been sold to commercial customers. In the Tentative Order, the Commission proposed that the EDCs conduct data gathering to estimate this percentage and classify the business type so that the proper value by business type can be utilized. The Commission also proposed that future versions of the TRM attempt to break out screw-based versus linear fluorescent HOU and peak CF, ideally using the results of the SWE’s Lighting Metering Study. In addition, the Commission proposed that, because the ISR is based on an upstream purchase, the default ISR should be based on the residential ISR rate.

1. **Comments**

No comments were received regarding the Commission’s proposed changes.

1. **Disposition**

The Commission adopts the additional guidance provided in the TRM. The Commission has also added language in the introductory section in the TRM clarifying that the parameter estimates in this section are for residential use only. The EDCs can conduct data gathering to determine the percent of bulbs sold and installed in various types of non-residential applications. The EDCs should use the CF and HOU by business type present in Section 3.2 (Commercial Lighting Equipment) of the TRM for non-residential bulb sales.

1. **Wall and Attic Insulation - Un-Insulated Wall R-Value**

In the 2013 TRM Final Order, the Commission directed the PEG to research whether or not un-insulated walls perform as R-5 or R-6 and provide recommendations for future TRM updates.[[132]](#footnote-132) Based on a review of the 2013 Illinois Statewide TRM and its sources on the topic,[[133]](#footnote-133) the SWE and the Commission believe that R-5 appears to be an appropriate R-value for an un-insulated wall. The Commission, therefore, proposed to update the default value in Table 2-35 from R-3 to R-5.

**a. Comments**

PennFuture/KEEA notes that there is no consideration of possible cooling load impacts of attic insulation, and that these savings should be modeled using an approved Home Performance software (to capture any IEs) and included in the protocol.[[134]](#footnote-134)

PECO recommends either adding additional insulation level options, or better still, allowing EDC data gathering for the baseline and retrofit R-values, and that it should be made clear that the assembly R-value is required, as opposed to the R-value of the insulation alone. PECO recommends that this CF be revised using an HVAC profile in Pennsylvania and the new peak period. PECO further comments that the options for EFLHcool and EFLHheat should also include the EDC-specific alternate EFLH from Tables 2-2 and 2-3 in Section 2.1.[[135]](#footnote-135)

PPL comments that the default value for Rwall,ee is R-9.0 based on the U.S. DOE’s recommendations to add R-6 to Rwall,bl, but since Rwall,bl has increased from R-3.0 to R-5.0, Rwall,ee should be increased to a default of R-11.0 instead of R-9.0.[[136]](#footnote-136)

**b. Disposition**

The Commission directs the PEG to investigate cooling load impacts of attic insulation and, if warranted, develop these savings impacts for future TRM updates using building simulation software or another appropriate method.

The TRM has been amended to allow EDC data gathering of baseline and retrofit R-values. Language has also been added to make clear that R-value means assembly R-value, as opposed to the R-value of the added insulation alone. The Commission agrees with PECO’s recommendation to revise CF and the Energy to Demand Factor using an HVAC profile in Pennsylvania and the new peak period; however, given that this will require review of data and development of a new CF and Energy to Demand Factor, the Commission directs the PEG to develop these new values for future TRM updates. The TRM has also been amended to include in Section 2.20 the EDC-specific alternate EFLH from Tables2-2 and 2-3 in Section 2.1. Finally, the Commission agrees with PPL’s recommendation to increase the default R-value of R wall,ee from R-9.0 to R-11.0 based on the increased R-value of R wall,bl from R-3.0 to R-5.0.

1. **Residential New Construction Protocols**

In the 2013 TRM Final Order, the Commission noted that there is an inverse relationship between the over-sizing factor of HVAC units and the CF and stated that further work should to be done to calculate the probability that an over-sized air conditioner is running at any given point during the peak period. The Commission directed the PEG to investigate and determine the amount by which the ENERGY STAR new homes program reduces over-sizing in residential homes, how the CF is affected and provide recommendations for future TRM updates.[[137]](#footnote-137)

Due to a lack of evidence to support the current over-sizing factor input present in the 2013 TRM, the Commission proposed to remove the over-sizing factor from the new construction protocol until updated studies provide the percent of standard efficiency new construction homes that install over-sized HVAC systems and the precise impact this over-sizing has on the efficacy of systems. The Commission proposed that this input be reviewed during future TRM updates.

* 1. **Comments**

PennFuture/KEEA suggests that a baseline be created for Pennsylvania residential construction practices. PennFuture/KEEA requests clarification on the defined values in Table 2-52 for air change rate per hour (ACH) in windows and doors, in addition to the whole house ACH value and its relation to the 2009 International Residential Code (IRC). Additional clarification is requested regarding the requirement for 50% of installed lighting to be efficient in the prescriptive path. PennFuture/KEEA comments that the furnace efficiency value is low by industry standards and that the CF for cooling is too high.[[138]](#footnote-138)

FirstEnergy states that Section 1.12.3 of the TRM addresses the interaction of the energy savings measures as they pertain to the building but does not address the interaction of lighting and appliances within the home energy rating tool. FirstEnergy insists that additional calculations are required to account for the effects of the loads of lighting and appliances in order to compare the efficient building to the baseline scenario. As a result, FirstEnergy recommends the removal of the entire statement: “For Residential New Construction, the interaction of energy savings is accounted for in the home energy rating tool that compares the efficient building to the baseline or reference building and calculates savings.” [[139]](#footnote-139)

* 1. **Disposition**

The Commission has chosen to reference the pertinent section N1102 of the 2009 IRC for the TRM. With regard to PennFuture/KEEA’s request to create a new baseline, and acknowledging that not all construction practices produce code compliant results, the Commission will not adopt a set of standards that are below the current construction code. With regard to Table 2-52, the values listed for windows and doors are representative of the IRC 2009 section N1102.4.4 requirements.[[140]](#footnote-140) To clarify the values outlined in the table for lighting, the 2009 IRC states in section N1104.1 Lighting Equipment: “A minimum of 50 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps.”[[141]](#footnote-141)

The Commission recognizes that the furnace sizing information and the CF required by improperly sized cooling equipment may need updating based on new research. As such, the Commission directs the PEG to review PennFuture/KEEA’s comments regarding this issue, as well as the appropriate industry information, and provide recommendations during future TRM updates.

The Commission rejects FirstEnergy’s request. The SWE performed an in-depth review of the REM/rate building energy simulation tool and determined that this software does adjust HVAC energy use for interactions with lighting and appliances. The SWE has also verified this with Architectural Energy Corporation, the developer of the REM/Rate Model.[[142]](#footnote-142)

1. **Ductless Heat Pump**
2. **Eligibility and Algorithms**
3. **Comments**

PECO suggests that a statement be added to the eligibility requirements explicitly stating that a zone have a defined baseline rather than each system having a defined baseline. PECO also suggests adding a savings factor to account for the absence of duct work heat gain/loss and another factor to account for the assumed low usage of ductless heat pumps (DHP) for primary heating, based on research regarding DHP usage in New York City.[[143]](#footnote-143)

1. **Disposition**

The Commission rejects the proposal that a zone be defined irrespective of the existing system that is heating or cooling it. The Commission furthermore rejects the request to add additional factors to account for the operating behavior of a group of systems until proper research is documented. The Commission directs the PEG to review the standards for baseline determination of mini-split heat pumps and provide recommendations during future TRM updates.

1. **Definitions and Terms**
2. **Comments**

PECO suggests that the equivalent cooling and heating load hours be representative of the prior residential section covering electrical HVAC. PECO also suggests that sources 7 and 9 in the definition of terms[[144]](#footnote-144) be expanded beyond referencing the TRM document. Furthermore, PECO recommends that the energy to demand factor be adjusted to represent the new peak period protocol.[[145]](#footnote-145)

PPL recommends adding a demographics-based table to be used as an alternative to the EFLH or billing analysis methods. PPL further suggests that the language in Section 2.16.6 be edited to reference “EDC data gathering” beyond “stipulated energy savings.” Lastly, PPL proposes an adjustment to the value SEERb in Table 2.29 to the value of 11.3 in order to align with the commercial DHP section table 3-68.[[146]](#footnote-146)

FirstEnergy recommends a review and adjustment to the load factor used in the algorithms to be representative of whether the DHP is a secondary or full house system. FirstEnergy also suggests that billing analysis be added as an option for pre- and post-metering data gathering.[[147]](#footnote-147)

1. **Disposition**

The Commission accepts the request to align the requirements of the equivalent load hours between residential sections and this is now addressed in the updates to the Electric HVAC protocols. In terms of referencing different portions of the TRM for sources, the Commission accepts this request and will include additional references for sources 7 and 9 during future TRM updates.

The Commission rejects adjustments to the energy to demand factor and equivalent load hours and the addition of a demographic table at this time due to a lack of information. We direct the PEG to review these suggestions and provide recommendations during future TRM updates.

The Commission has modified Section 2.16.6 to allow for billing analysis in lieu of stipulated energy savings. The Commission accepts the adjustment of the SEERb value definition to align with other sections of the TRM. The Commission also accepts the addition of “billing analysis” as an approved impact analysis methodology for determining the savings due to installation of a DHP.

The Commission rejects the modifications to the load factor protocol as the issue needs further substantiation. As such, the Commission directs the PEG to determine the appropriate modifications and provide recommendations during future TRM updates.

1. **ENERGY STAR Appliances**
2. **ENERGY STAR Certification Delay**
3. **Comments**

PECO comments that there is often a delay when a unit becomes available in the marketplace and when it actually earns the ENERGY STAR label. There are also several manufacturers that have chosen not to pay for the ENERGY STAR label even though their products meet the ENERGY STAR criteria. PECO recommends that the language in the TRM be clarified to include products meeting the ENERGY STAR criteria even if they are not ENERGY STAR labeled with product qualification being confirmed through review of the AHRI testing reports.[[148]](#footnote-148)

1. **Disposition**

This Commission agrees with PECO that the delay in ENERGY STAR certification can result in highly efficient products deemed ineligible for the program. To remedy this issue, the Commission has included language in the TRM that states that, if a customer submits a rebate for a product that has applied for ENERGY STAR certification but has not yet been certified, the savings will be counted for that product contingent upon its eventual certification as an ENERGY STAR measure. If, at any point, the product is rejected by ENERGY STAR, the product is then ineligible for the program and savings will not be counted. Products meeting the ENERGY STAR criteria are allowed for, so long as the product qualification is confirmed through review of the AHRI testing reports.

1. **ENERGY STAR Clothes Washers**
2. **Comments**

PennFuture/KEEA comments that the measure characterization on ENERGY STAR Clothes Washers is not clear as to the basis for the percentage of total wash cycle energy use allocated to dryer use. Additionally, PennFuture/KEEA notes that the current measure does not consider homeowners using line drying.[[149]](#footnote-149)

1. **Disposition**

The Commission agrees with PennFuture/KEEA that the percentage of total wash cycle energy is incorrectly sourced in Table 2-61 and the commission has amended the TRM accordingly. Due to a lack of information currently available on homeowners using line drying, the Commission directs the PEG to review the potential inclusion of this percentage and provide recommendations for future TRM updates.

1. **ENERGY STAR Refrigerators and Freezers**

The 2013 TRM deemed energy savings for ENERGY STAR refrigeratorsand ENERGY STAR freezers were calculated by averaging the available models from the ENERGY STAR qualified products list as it appeared in August of 2012. In the Tentative Order, the Commission proposed to update the deemed savings during each TRM update to reflect the energy usage of the ENERGY STAR models on the qualified products list and their equivalent baselines available at the time of the TRM update. The Commission believes that averaging the annual energy usage of ENERGY STAR products available to consumers and their equivalent federal baselines will produce credible savings estimates.

1. **Comments**

PennFuture/KEEA questions if the savings for ENERGY STAR Refrigerators were informed by actual program data. Additionally, in regards to the deemed savings values, PennFuture/KEEA expresses concern with using the current federal standard as baseline for ENERGY STAR refrigerators given high ENERGY STAR market share and the September 2014 federal standard upgrade.[[150]](#footnote-150)

PECO comments that the savings protocols for ENERGY STAR refrigerators and ENERGY STAR freezers underestimate savings. This is due to the fact that the formulas provided calculate the maximum allowable energy consumption, not the actual energy consumption of the installed unit. PECO recommends these two sections be modified to allow use of the actual incented refrigerator and freezer test data for annual energy consumption to calculate energy savings.[[151]](#footnote-151)

1. **Disposition**

The Commission notes that usage data for ENERGY STAR refrigerators and freezers were taken directly from the available models from the ENERGY STAR qualified products list. The usage for the baseline refrigerators and freezers was taken directly from the federal baseline on the ENERGY STAR calculator. While the Commission agrees that the federal baseline may overestimate savings given the market saturation of ENERGY STAR models, the Commission believes this is the best estimate at this time. The Commission will revisit this baseline issue for future TRM updates when results from the Phase II Baseline Studies[[152]](#footnote-152) are published.

Additionally, the Commission notes that the default savings values for ENERGY STAR refrigerators and freezers are not directly informed by Pennsylvania program-specific data. However, the Commission will allow the EDCs to conduct their own studies and/or use manufacture test data on the rebated appliances and use the deemed savings algorithm to calculate program-specific results.

1. **ENERGY STAR Televisions**

The 2013 TRM energy savings for ENERGY STAR televisions[[153]](#footnote-153) reflected the federal standards for ENERGY STAR 5.3 televisions. The Commission notes that Federal ENERGY STAR standards for version 6.0 televisions became effective June 1, 2013. The Commission, therefore, proposed to update the protocol for the TRM to reflect these new standards. The Commission further notes that the federal baseline standard has not been updated from the version 5.0 ENERGY STAR television and proposes that it remain consistent with the 2013 TRM.

1. **Comments**

PennFuture/KEEA comments that the baseline assumptions for ENERGY STAR televisions are outdated and should be raised to the ENERGY STAR v5.3 TV. It notes that television efficiency has improved greatly and using v3.0 significantly overestimates baseline energy use and savings. PennFuture/KEEA cites the 2013 NEEP Business and Consumer electronics report that says 84% of national TV shipments were ENERGY STAR compliant in 2012 to the v5.3 specification.[[154]](#footnote-154)

1. **Disposition**

The Commission reviewed the cited NEEP report and agrees with PennFuture/KEEA that using the ENERGY STAR v3.0 Television as a baseline overestimates the savings. The Commission has updated the TRM to use the baseline of ENERGY STAR v.5.3 Television.

1. **Electric Clothes Dryer with Moisture Sensor**

In the 2013 TRM Final Order, the Commission directed the PEG to review the analyses from sources regarding the expected equipment life for electric clothes dryers and provide recommendations for future TRM updates. The Commission proposed to update the expected life to 13 years based on review of ENERGY STAR[[155]](#footnote-155) and National Association of Home Builders (NAHB)[[156]](#footnote-156) studies.

1. **Comments**

PECO and PennFuture/KEEA comment that, although estimated savings appear to be in line with ENERGY STAR estimates, a new ENERGY STAR specification for clothes dryers is anticipated in early 2014 and will likely be available for inclusion in the 2015 TRM.[[157]](#footnote-157) PECO also suggests revising the measure now in anticipation of the upcoming ENERGY STAR specification, using draft ENERGY STAR minimum Combined Energy Factor (CEF). PECO also comments that it appears that the CF has not been updated to reflect the new peak demand period, and that a load shape for clothes dryers should be used from the Building America Benchmarks Database for PA cities.[[158]](#footnote-158)

1. **Disposition**

The Commission agrees that the measure should incorporate the new ENERGY STAR specification after the specification becomes available. The Commission directs the PEG to review the new specification when it becomes available and consider how to revise the measure for future TRM updates based on the new specification and PECO’s suggestions on CEF.

The Commission agrees with PECO’s recommendation to revise the CF and the Energy to Demand Factor using load profiles for Pennsylvania and the new peak period. We note, however, that given that this will require review of data and development of a new CF and Energy to Demand Factor, the Commission directs the PEG to develop these new values for inclusion in future TRM updates.

1. **ENERGY STAR Room Air Conditioners**

The Commission proposed to update this protocol to reflect the Federal ENERGY STAR standards for Version 3.0 Room Air Conditioners.

1. **Comments**

PECO comments that the summer demand savings per purchased ENERGY STAR room AC (DSAVRAC) and CF each list references, yet no details are provided about the specific inputs that went into those references. PECO also notes that, through an independent third party study, it found that, in medium density areas, the CF for a room air condition (CFRAC) is 0.30, not the default value of 0.58 given in Table 2-22. PECO also requests the ability to use EFLHcool values from Section 2.1 (Tables 2-1 and 2-2) in lieu of EFLHES-RAC given in Table 2-23.[[159]](#footnote-159)

1. **Disposition**

The Commission directs the PEG to review the factor DSAVRAC and CF and provide recommendations for future TRM updates. The Commission will allow optional EDC data gathering for use in the CFRAC metric, but will leave the default value as 0.58. The Commission agrees that the EFLHcool values from Section 2.1 can be used since the EFLHES-RAC values are being treated as Central Cooling values to be corrected by a 0.31 multiplier.

1. **Water Heating Measure Protocols**
2. **Efficient Electric Water Heaters**

During the 2013 TRM update, PECO commented that the energy factors of most new electric water heaters are higher than 0.95 and that the current deemed savings based on energy factors of 0.93-0.95 understate savings.[[160]](#footnote-160) The Commission proposed to revise the protocol to allow the nameplate energy factor of a new water heater to be entered into a simplified algorithm in order to calculate savings.

1. **Comments**

PennFuture/KEEA suggests that this measure be deleted because the savings are small, there is no data to support the baseline at the federal minimum and the measure competes with the much larger savings opportunity from heat pump water heaters.[[161]](#footnote-161)

PECO comments that the algorithm should be revised and provides a corrected algorithm. It also states that it appears that the Energy to Demand Factor has not been updated to reflect the new peak demand period, and that it should be revised using a water heater load profile provided by PECO. PECO and PPL state that the default savings algorithm contains an error and should be corrected.[[162]](#footnote-162)

1. **Disposition**

The Commission does not believe it has adequate information, at this time, to warrant the deletion of this measure. As such, we direct the PEG to review PennFuture/KEEA’s proposal and provide recommendations during future TRM updates.

We agree with PECO’s recommendation to update the algorithm and sources and have updated the TRM accordingly. The Commission also agrees with PECO’s recommendation to revise the Energy to Demand Factor using load profiles for Pennsylvania and the new peak period. We, however, note that as this will require review of data and development of a new Energy to Demand Factor, the Commission directs the PEG to develop these new values for inclusion in future TRM updates. The Commission has updated the default savings algorithm per the comments of PECO and PPL.

1. **Heat Pump Water Heaters**

During the 2013 TRM update, PECO commented that the energy factors of many new electric water heaters being incented are higher than 2.3 and that the current deemed savings based on energy factors of 2.2-2.3 understate savings.[[163]](#footnote-163) The Commission proposed to revise the protocol to allow the nameplate energy factor of a new water heater to be entered into a simplified algorithm in order to calculate savings.

1. **Comments**

PennFuture/KEEA states that assuming this measure is installed in an attic or garage location is unlikely given freezing conditions and suggests that the Commission consider space heat penalties and cooling interaction benefits for units located in conditioned spaces.[[164]](#footnote-164)

PECO comments that it appears that the Energy to Demand Factor has not been updated to reflect the new peak demand period, and that it should be revised using a water heater load profile provided by PECO. PECO also provides a corrected algorithm. PECO and PPL comment that the default savings algorithm contains an error and should be corrected.[[165]](#footnote-165)

1. **Disposition**

The Commission agrees with PennFuture/KEEA regarding the likely location of heat pump water heaters and the IE of units in conditioned spaces and believes further review is required. As such, we direct the PEG to investigate the issue further and provide recommendations in future TRM updates.

The Commission agrees with PECO’s recommendation to revise the Energy to Demand Factor using load profiles for PA and the new peak period. We note, however, that as this will require review of data and development of a new Energy to Demand Factor, the Commission directs the PEG to develop these new values for inclusion in future TRM updates. Additionally, the default savings algorithm has been corrected.

1. **Fuel Switching to Alternative Fuels**

The 2013 TRM includes only natural gas as an alternative fuel for water heating fuel-switching measures. The Commission proposed to include protocols allowing for a switch from electricity to propane or oil. In addition, the Commission proposed that the EDCs use the same algorithms for new alternative fuels to estimate savings and alternative fuel consumption.

1. **Comments**

PECO comments that the default values for the removed electric unit’s energy factor and resulting energy savings in Table 2-33 should be replaced with a deemed algorithm for determining energy savings. PECO notes that this would make this measure a default value for the electric unit’s energy factor and allows the default savings to be based on tank size. PECO also suggests that the algorithms for energy savings and fuel consumption be updated to include a factor that will convert the calculations into the correct respective units.[[166]](#footnote-166)

PennFuture/KEEA questions whether this measure screens from a TRC perspective and provides significant savings to the consumer, particularly for oil.[[167]](#footnote-167)

1. **Disposition**

The Commission accepts PECO’s recommendation to delete Table 2-33 and instead include a deemed algorithm for energy savings. The Commission agrees that the inclusion of a deemed algorithm rather than a table of default values will be more helpful and will allow for EDC calculations of savings of all tank sizes. The Commission also accepts PECO’s recommendation to include the recommended conversion factor.

Regarding PennFuture/KEEA’s questions, the rationale for this measure is that fuel switching from heat pump water heaters generates electric savings for the customer. Because of this, it gives the EDCs an opportunity to provide electric savings to their customers and meet their savings goals. Measures in the 2014 TRM do not need to pass the TRC as individual measures as long as the EDC’s plan portfolio is cost-effective.

1. **Fuel Switching to ENERGY STAR Measures**

In the Tentative Order, the Commission proposed to update the fuel consumption of the replacement units to reflect the ENERGY STAR standard for natural gas and propane water heaters. In addition, the Commission noted that ENERGY STAR does not currently have a standard for oil water heaters. As such, the Commission proposed that the fuel consumption for oil water heaters remain equivalent to the federal standard.

1. **Comments**

PECO recommends that the language in the TRM be clarified to include products meeting the ENERGY STAR criteria even if they are not ENERGY STAR labeled with product qualification being confirmed through review of the AHRI testing reports. PECO also states that the values for the efficiency of all installed units should be modified to allow input of energy factors of actual incented units. Additionally, PECO recommends the addition of a deemed algorithm for fossil fuel consumption. [[168]](#footnote-168)

1. **Disposition**

This Commission agrees with PECO that the delay in ENERGY STAR certification can result in highly efficient products deemed ineligible for the program. To remedy this issue, the Commission has included language in the TRM that states that, if a customer submits a rebate for a product that has applied for ENERGY STAR certification but has not yet been certified, the savings will be counted for that product contingent upon its eventual certification as an ENERGY STAR measure. If, at any point, the product is rejected by ENERGY STAR, the product is then ineligible for the program and savings will not be counted. Products meeting the ENERGY STAR criteria are allowed for, so long as the product qualification is confirmed through review of the AHRI testing reports.

The Commission accepts PECO’s recommendation to allow EDC Data Gathering for the efficiencies of installed units. The Commission also accepts PECO’s recommendation to provide a deemed algorithm for fossil fuel consumption.

1. **Solar Water Heating**

The Solar Water Heater measure protocol was not discussed in the Commission’s Tentative Order. However, comments were provided regarding this measure and are addressed below.

1. **Comments**

PECO notes that the algorithm for the savings from a solar water heating system needs to be revised so that the calculation will produce savings expressed in kWh, not Btus. PECO also recommends that in addition to the default savings, a partially deemed algorithm could be provided similar to the other water heater measures. This reflects the revision of this measure to a default value for EF base and EF proposed rather than a deemed value, and also reflects allows the default savings to be based on tank size.[[169]](#footnote-169)

1. **Disposition**

The Commission agrees with all of PECO’s suggestions except one. With regard to a partially deemed algorithm for solar water heating savings, the Commission believes more information is necessary. As such, we direct the PEG to review the option of developing a partially deemed algorithm for solar water heating savings and provide recommendations during future TRM updates.

1. **Electric Water Heater Pipe Insulation**

This measure was not addressed in the Commission’s Tentative Order. However, comments were provided regarding this measure and are addressed below.

1. **Comments**

PPL suggests adding a six foot default value for the length of insulation as an option. This would provide EDCs with an option to use the default in lieu of requiring customers or CSPs to measure the length at each site. PPL notes that this step is intrusive to customers, unnecessarily costly for evaluators, and is not warranted given the relatively low savings for this measure and the very small contribution to portfolio savings. The six foot length is based on the typical length of un-insulated, accessible hot water piping above an electric water heater.[[170]](#footnote-170)

1. **Disposition**

The Commission rejects PPL’s recommendation to add a six foot default value for the length of insulation. While the Commission recognizes the effort required by customers and CSPs to measure the length of pipe insulated, the Commission notes that this effort is important in calculating accurate savings as pipe length can vary greatly by customer and a six-foot average value could significantly over- or underestimate savings. Additionally, the Commission notes that the protocol allows for the length of insulation to be determined using a sample approach.

1. **Water Heater Tank Wrap**

This measure was not addressed in the Commission’s Tentative Order. However, comments were provided regarding this measure and are addressed below.

1. **Comments**

PennFuture/KEEA comments that the baseline default assumes one inch of polyurethane foam with an R-12 rating, but polyurethane foam has a lower value of about R-6.5 per inch. PECO states that, while a new definition has been added for R-value, it would be more useful to include a text definition.[[171]](#footnote-171)

1. **Disposition**

The Commission notes that the default water heater tank insulation value used in Section 2.42 is R-8.33 and is based on a credible source rather than the assumed value that is currently used in Section 2.38. The TRM has been amended to update the baseline water heater tank insulation level from R-12 to R-8.33 in Section 2.38. The TRM has also been amended to provide a text definition of R-value in Section 2.38.2.

1. **Low Flow Faucet Aerators**

The 2013 TRM relied on several other TRMs and citations for low flow faucet aerators that have since been updated to reflect the most current published studies. Based on a review of data the Commission proposed to update the following parameters: 1) daily water faucet usage; 2) differentiation between kitchen and bathroom faucet aerators; 3) differentiation between single and multifamily housing; 4) drain factor; and, 5) electric water heater saturation.

Previous versions of the TRM did not distinguish between kitchen and bathroom faucet aerators. The Commission believes that identifying the aerator type is a more accurate approach to estimating savings for these measures. The Commission proposed that the average kitchen usage be 4.5 minutes per person, per day and that the bathroom usage be 1.6 minutes per person, per day. Additionally, a default value of 6.1 minutes per person, per day is proposed for use if the installation location is unknown.

The average persons per household and average faucets per home should be updated to reflect the most recent data gathered in the PA Residential Baseline Study. While the average number of persons per household remained constant at 2.6 persons per household, the Commission proposed that the differentiation between a single family installation and a multifamily installation be included. The Commission also proposed that the number of faucets per home be increased to 3.8 faucets. Allowing the faucet type to be identified increases the precision of the savings estimate, resulting in an average of one kitchen faucet and 2.8 bathroom faucets per home. The Commission proposed that both of these parameters be changed to an open variable.

The Commission also proposed that the drain factor parameter be updated to reflect the location of the aerator resulting in a drain factor of 75% for kitchen faucets, 90% for bathroom faucets and 79.5% for unknown faucets.

For program offerings that distribute energy savings kits with low flow faucet aerators to homes where the water heater fuel type is unknown the Commission proposed to open this parameter to allow EDCs to use gathered data or to incorporate additional information pertaining to a given EDC’s percentage of electric water heaters in its service territory. Otherwise, the default value would be the statewide 43%. The default value of 43% is based on the PA Residential Baseline Study.[[172]](#footnote-172)

* 1. **Comments**

FirstEnergy and PPL state that the ISR, if applied for demand, would be double-counted because demand is a function of the energy savings, which also received the ISR discount. PPL also seeks clarification on whether the EDCs can use the fully deemed savings values listed in the introductory table. PPL notes that the average hot water usage time per person per day is incorrect for the “unknown” installation location.[[173]](#footnote-173)

PECO suggests that deemed values in the introductory table be replaced with “Varies by installation location.” PECO also requests that the savings algorithm be modified to allow input of the water temperature difference between water into the home relative to water flowing from the faucet. PECO recommends that the gallon per minute (GPM) flow rate for baseline and efficient faucets be open variables. PECO requests that, in addition to the adjusted flow times, other factors from the Michigan metering study[[174]](#footnote-174) be included. Additionally, PECO requests that the number of faucets per home values be added for multifamily homes from either the Pennsylvania Residential Baseline Study or the Illinois TRM. PECO recommends that default savings values be displayed in tabular format rather than the current text description and provides actual default values it feels warrant inclusion. Finally, PECO believes the Energy to Demand Factor has not been updated to represent coincident demand for the new peak demand period.[[175]](#footnote-175)

* 1. **Disposition**

The Commission agrees with FirstEnergy and PPL that the ISR should be removed from the demand algorithm to avoid double-counting. Regarding PPL’s requested clarification on the use of deemed savings values these deemed savings values have been replaced with “Varies by installation location.” The Commission recommends the use of site-specific information to assign savings, but in the absence of site specific information, defaulting to the TRM-based partially deemed savings values included in Section 2.8.3 is sufficient. A new table (Section 2.8.3) has been added that provides partially deemed savings by faucet and household type. The EDCs have the ability to input utility/project-specific data into the algorithm where noted in the variable descriptions.

The Commission disagrees with PPL that the average hot water usage time per person per day is incorrect for the “unknown” installation location. It is correct to use the summed value of bathroom and kitchen average hot water usage time per person per day because the algorithm divides by the total number of faucets in the home for the “unknown” installation location. This corresponds to an average hot water usage time per person per day of 6.1 minutes: 1.6 minutes for bathroom + 4.5 minutes for kitchen.

The Commission agrees with PECO’s requests to have the savings algorithm modified to allow input of the water temperature difference between water into the home relative to water flowing from the faucet, as well as to change the GPM flow rate for baseline and efficient faucets to open variables.

The Commission is in favor of incorporating additional factors from the Michigan metering study into the TRM update. However, the Commission was unable to verify PECO’s proposed GPM values for both baseline and post-installation. Consequently, the Commission opts to use the rated GPM of the aerators for both baseline and post-installation, as was done in the Michigan metering study. Discounted GPM flow rates were not applied because the “throttle factor” adjustment was found to have been already accounted for in the mixed water temperature variable, which is accounted for in the current algorithm. Additionally, the GPMBase was set to a default value of 2.2 due to the inability to verify what the GPM flow rate was of the replaced faucet. The Commission believes that PECO made an error in the stated value of 91ºF for the kitchen temperature out parameter. This has been revised to 93ºF to accurately reflect the value originating from the Michigan metering study. Therefore, the updated parameters from the Michigan metering study are GPMBase = 2.2; GPMLow = 1.5; Kitchen Temperature Out: Tout = 93; Bathroom Temperature Out: Tout = 86; Unknown Faucet Type Temperature Out: Tout = 87.8; and, Temperature In: Tin = 55.

The Commission agrees that the number of faucets per home should be broken out by household type. The algorithm has been adjusted to reflect the appropriate values found in the PA Residential Baseline Study data.

The Commission agrees that a table containing the default savings values should replace the current text description in section 2.8.3. However, the Commission rejects the values that were presented in the PECO version of the table in favor of an updated table that contains values based off of the verified inputs mentioned above. The Commission agrees that the Energy to Demand Factor had not been updated to represent coincident demand for the new peak demand period. The ratio of the average energy usage during 2 PM and 6 PM on summer weekdays to the total annual energy usage is taken from average daily load shape data collected for faucets and showerheads from a study conducted by Aquacraft, Inc.[[176]](#footnote-176) In addition, statewide parameters have been incorporated as the input values in the Energy to Demand Factor algorithm components.

1. **Low Flow Showerheads**

In the Tentative Order, the Commission proposed updates to this measure to reflect more up-to-date information. The Commission believed that the average number of persons and showers per household should be updated to incorporate a default value when household type is unknown. The Commission proposed the use of the default values of 2.6 persons and 1.6 showers per household, based on statewide averages from the PA Residential Baseline Study. The Commission proposed that these parameters be made open to allow for EDC data gathering.

The Commission also proposed to update the recommended average gallons of hot water used for showering from 11.6 gallons per person, per day to 11.7 gallons per person, per day based upon the 2013 Michigan metering study. The 2013 Michigan metering study also recommends a showerhead water temperature of 101ºF, which the Commission proposed to adopt for the 2014 TRM. The 2013 TRM includes 105ºF as shower water temperature, which is sourced from the 2013 Illinois TRM. However, the 2013 Illinois TRM cites a study from 1994 to support the use of this value, [[177]](#footnote-177) which the Commission feels is now outdated information.

For program offerings that distribute energy savings kits with low flow faucet aerators to homes where the water heater fuel type is unknown the Commission proposed to open this parameter to allow EDCs to use gathered data or to incorporate additional information pertaining to a given EDC’s percentage of electric water heaters in its service territory. Otherwise, the default value would be the statewide 43%. The default value of 43% is based on the PA Residential Baseline Study.[[178]](#footnote-178)

* 1. **Comments**

PECO recommends consistent algorithms be used between the showerhead and faucet aerator measures, and supports including the same recommendations as made for faucet aerators. PECO also requests that default savings values be updated to reflect those presented in Table 7, which should replace the current table. Finally, PECO believes the Energy to Demand Factor has not been updated to represent coincident demand for the new peak demand period. This factor should be revised using the provided water heater load profile in Figure 2-5 and the new peak period, and the section text updated accordingly.[[179]](#footnote-179)

* 1. **Disposition**

The Commission agrees with PECO’s recommendation that the showerhead and faucet aerator algorithms be as similar as possible with regards to variable naming convention and allowing for open variables. The current default savings table (Table 2.9.4) contains identical default savings values as the “Upstream Program Unit Energy Savings (kWh)” values put forth by PECO. The Commission rejects the inclusion of the Direct Install Program Unit Energy Savings (kWh) column in the default savings table due to the Commission’s inability to verify the proposed flow rate of 2.63 GPM for direct install programs targeting high flow devices. However, if the EDCs have reliable primary data to support this value, the EDCs can incorporate the data into the algorithm as EDC data gathering.

The Commission agrees that the Energy to Demand Factor had not been updated to represent coincident demand for the new peak demand period. The ratio of the average energy usage during 2 PM and 6 PM on summer weekdays to the total annual energy usage is taken from average daily load shape data collected for faucets and showerheads from a study conducted by Aquacraft, Inc.[[180]](#footnote-180) In addition, statewide parameters have been incorporated as the input values in the Energy to Demand Factor algorithm components.

1. **Residential Occupancy Sensors**

The EDCs have requested changes to keep this measure consistent with the residential lighting protocols, such as the inclusion of the IE input in the algorithm.

* 1. **Comments**

PennFuture/KEEA asks if the 30% reduction in HOU has recent New England evaluations to support the value. PECO requests that the occupancy sensor algorithm be updated to include an input for IEs, as is present in Section 2.29. Additionally, PECO recommends that this algorithm be updated to use similar variable inputs as the other residential lighting protocols in the TRM.[[181]](#footnote-181)

* 1. **Disposition**

The Commission does not have evaluations submitted from New England utilities to evaluate the 30% reduction in HOU. The Commission rejects PECO’s request to update the algorithms with variable inputs, including IEs. Occupancy sensors are not exclusive to a particular lighting technology or conditioned spaces and therefore the reduction of hours may not have the same effects on the HVAC systems as the energy efficient lighting technologies. The inclusion of IEs would require EDC knowledge of the lighting technology, pre- and post-installation load shapes, as well as modeling to account for change in HOU. If this data and analyses become available, IE for occupancy sensors can be considered during future TRM updates. The Commission has updated the occupancy sensor algorithm to have similar terminology and flow as the ENERGY STAR Residential Lighting protocol.[[182]](#footnote-182)

1. **Room AC Retirement**

The Room AC (RAC) Retirement measure protocol estimates energy savings from removing old Room AC Units without replacement. This measure was not discussed in the Tentative Order. However, comments were received on this measure and are addressed below.

* + - 1. **Comments**

PECO comments that an independent third party study shows that, in medium density areas, the CFRAC is 0.30, as opposed to the default value of 0.58 given in Table 2‑22. PECO requests the ability to use EFLHCOOL values from Section 2.1 (Tables 2-1 and 2-2) in lieu of EFLHES-RAC given in Table 2-23.[[183]](#footnote-183)

PennFuture/KEEA comments that the installed capacity of 10,000 Btuh, the 58% CF, and the 9.07 default for retired equipment energy efficiency ratio (EER) all seem high and asks whether the default capacity could be informed by program activity. Also, a new ENERGY STAR specification became effective in October 2013, and a new Federal RAC standard expected in June 2014 will use a revised efficiency metric that includes standby losses.[[184]](#footnote-184)

* + - 1. **Disposition**

The Commission will allow optional EDC data gathering for use in the CFRAC metric, but will leave the default value as 0.58. The Commission agrees that EFLHCOOL values from Section 2.1 can be used since the EFLHES-RAC values are being treated as Central Cooling values to be corrected by a 0.31 multiplier. The Commission directs the PEG to research the measure further and determine if information exists that indicates the installed capacity, CF and default EER for retired equipment are being overstated and determine if revisions are needed for future TRM updates. The Commission also directs the PEG to consider whether program activity could be used to determine installed capacities for Pennsylvania and to consider the new ENERGY STAR and Federal RAC standards in determining what revisions are necessary for future TRM updates.

1. **Programmable Thermostat**

This measure was not discussed in the 2014 Tentative Order. However, comments were received on this measure and are addressed below.

1. **Comments**

PECO recommends updating the default seasonal energy efficiency ratio (SEER) from that provide by Source 2 to 13.5, from a study PECO performed. PECO requests to be able to use EFLHCOOL and EFLHHEAT values from Tables 2-2 and 2-3 in Section 2.[[185]](#footnote-185)

1. **Disposition**

The Commission will also raise the baseline from Source 2 to 11.9 SEER, which is the average value from the PA Residential Baseline Study. Additionally, a baseline average SEER from EDC data gathering is permissible if available. The Commission agrees with PECO and will permit use of EDC-specific values for EFLHCOOL and EFLHHEAT in Tables 2-2 and 2-3.

1. **Pool Pump Load Shifting**

Because a customer’s default base connected load is not necessarily a readily available data point, the Commission proposed to add a default value of 1.364 kW to Table 2-89[[186]](#footnote-186) for the base connected load.

1. **Comments**

PECO comments that the definitions and values of CFpre and CFpost should be updated to reflect the new peak demand period. Additionally, PECO believes that the recommended evaluation protocol verification should refer to an average daily load shape rather than the run time. Load shifting verification requires estimates of coincidence rather than hours of operation per day.[[187]](#footnote-187)

1. **Disposition**

The Commission agrees with PECO’s recommendation to revise CF using load profiles for Pennsylvania and the new peak period. We note, however, that this will require review of data and development of a new CF, which the Commission directs the PEG to develop for inclusion in future TRM updates. The Commission also agrees with PECO’s recommendation to revise the evaluation protocol in 2.39.5 to require an estimate of coincidence rather than just hours of operation.

1. **Variable Speed Pool Pump**

Because a customer’s default base connected load is not necessarily a readily available data point, the Commission proposed to add a default value of 1.364 kW to Table 2-93[[188]](#footnote-188) for the base connected load. The Commission also proposed to correct a circular reference in the algorithms for calculating peak demand.

1. **Comments**

PennFuture/KEEA comments that the CFs appear to vary significantly between the two pool pump measures. A default kW may be needed, varying by pump HP, and informed by over a decade of pool pump programs in California.[[189]](#footnote-189)

PECO comments that the eligibility text in Subsection 2.40.1 should be updated to clarify whether this is a retrofit measure, a replace on burnout measure, or some blend of the two, and also to show the correct new peak demand period. PECO suggests that the definitions and values for CFss and CFvfd be updated to represent the new peak demand period. PECO believes that the energy and demand savings algorithms should account for pumps operating in several modes. Additionally, kWvfd should be broken into at least kWvfd\_cleaning and kWvfd\_filtration (where demand in filtration mode is higher) and kWhvfd should be broken into at least kWhvfd\_cleaning and kWhvfd\_filtration. Lastly, PECO recommends that the evaluation protocol Subsection 2.40.6 be amended to include recommendations that evaluators work with pool service professionals, in addition to surveying customers, in order to obtain pump settings that may lead to additional and more accurate data points. Tracking variable speed pump settings can expedite verification activities.[[190]](#footnote-190)

1. **Disposition**

Due to a lack of information, the Commission directs the PEG to review the concerns raised by PennFuture/KEEA regarding CFs, default pump size and the possibility of incorporating a default kW and provide recommendations during future TRM updates.

The TRM has been amended with the updates to the eligibility Subsection 2.40.1 requested by PECO. The Commission also agrees with PECO’s recommendation to revise CFss and CFvfd using load profiles for Pennsylvania and the new peak period. We note, however, that this will require review of data and development of a new CF and Energy to Demand Factor, which the Commission directs the PEG to develop for inclusion in future TRM updates. The Commission Further agrees with PECO’s comment regarding the need for multiple operating modes for variable speed pool pumps and the need to reflect this in the algorithms. The Commission directs the PEG to research variable speed pool pump operating modes, make a recommendation on the operating modes that should be represented in the algorithms as well as appropriate default demand values for future TRM updates.

1. **Furnace Whistle**

The Commission proposed to revise the protocol to include an algorithm for calculating peak demand reduction for furnace whistles. The Commission also proposed adding a CF of 70% to Table 2-5 to allow for calculation of peak demand.[[191]](#footnote-191)

1. **Comments**

PennFuture/KEEA notes that there are no evaluated savings to reference for this measure; that the current savings estimate likely overstates savings from an engineering perspective; and, that the ISR is from a source that is over ten years old. PECO recommends that this CF and the Energy to Demand Factor be revised using and HVAC profile in Pennsylvania and the new peak period.[[192]](#footnote-192)

1. **Disposition**

Due to a lack of information, the Commission directs the PEG to research the measure further to determine if better estimates of savings and ISR are available and to provide recommendations during future TRM updates.

The Commission agrees with PECO’s recommendation to revise CF and the Energy to Demand Factor using load profiles for Pennsylvania and the new peak period. We note, however, that this will require review of data and development of a new CF and Energy to Demand Factor, which the Commission directs the PEG to develop for inclusion in future TRM updates.

1. **Smart Plug Outlets**

In the 2013 TRM Final Order, the Commission agreed with comments[[193]](#footnote-193) that the deemed savings per Smart Plug strip should be significantly lower than the value of 184 kWh shown in the 2013 TRM based on a recent study by the Energy Center of Wisconsin.[[194]](#footnote-194) The Commission directed the PEG to review the appropriate savings value for this protocol and provide recommendations for future TRM updates. Based on a review of an Energy Center of Wisconsin study and another study on the subject completed by ECOS,[[195]](#footnote-195) the Commission proposed to reduce the average connected loads for entertainment centers and computer systems. Additional research indicates that the CFs for Smart Plug strips should be increased to 0.80[[196]](#footnote-196) and that the measure life should be lowered to four years.[[197]](#footnote-197) The Commission also proposed that the average daily idle time be increased to 20 hours. The resulting average savings from the existing algorithms for a default five-plug Smart Plug strip, in which the intended use is unknown, were calculated to be 48.9 kWh. If the intended use is known to be with an entertainment center, default savings were calculated to be 62.1 kWh for 5-plug Smart Plug strips. The Commission proposed the adoption of these values within the protocol and the addition of the 62.1 kWh savings value be added to Table 2-23.[[198]](#footnote-198)

Additionally, during the 2013 TRM update, parties commented that the savings for a seven-plug Smart Plug strip would be expected to be higher than the savings for a five-plug Smart Plug strip.[[199]](#footnote-199) In order to approximate additional savings potential for a seven-plug Smart Plug strip while also considering that some consumers may buy a seven-plug Smart Plug strip for future capacity and not use all of the plugs, the SWE and the Commission assumed that six of the seven plugs would be used. Savings for the seven-plug Smart Plug strip were therefore estimated to be 20% higher than the savings for a five-plug Smart Plug strip. The Commission proposed the adoption of these values and their addition to Table 2-23. Specifically, the Commission proposed 58.7 kWh for a seven-plug Smart Plug strip with unknown intended use and 74.5 kWh for a seven-plug Smart Plug strip with the known use intended to be for an entertainment center.

1. **Comments**

PennFuture/KEEA believes that the references may be outdated and questions whether idle time by kW has decreased as overall efficiency of televisions and computers has increased. FirstEnergy states that the calculations for Smart Strip savings appear to lack an ISR and suggests that the ISR source should be EDC Data Gathering since these items are distributed through direct install, direct delivery and point-of-sale rebates. PECO recommends that this CF be revised using a load profile from the Building America Benchmarks database for Home Entertainment Appliances in Pennsylvania and the new peak period.[[200]](#footnote-200)

1. **Disposition**

The Commission directs the PEG to research the measure further to determine if more recent research or information is available about idle time and the overall efficiency of televisions and computers and to provide recommendations during future TRM updates.

The TRM has been updated to include an ISR in the Smart Strip savings algorithm, to be determined by EDC Data Gathering. The Commission agrees with PECO’s recommendation to revise CF using load profiles for Pennsylvania and the new peak period. We note, however, that this will require review of data and development of a new CF and Energy to Demand Factor, which the Commission directs the PEG to develop for inclusion in future TRM updates.

The Commission also agrees with the PECO comment regarding the measure life reference and directs the PEG to determine whether additional information on the current reference for measure life of Smart Strips exists, or whether more recent data exists, and provide recommendations during future TRM updates. The Commission notes that this measure life value and reference are used in the Illinois Statewide TRM.

1. **Refrigerator/Freezer Recycling**

The 2013 TRM utilized the U.S. DOE UMP as the primary basis for deemed savings for refrigerator removal/replacement. For the 2013 TRM, the Commission declined to adopt the portion of the U.S. DOE UMP relating to estimating the impact on measure savings when a removed appliance gets replaced with a new appliance. In the Tentative Order, the Commission proposed that the algorithms for deemed savings for refrigerator and freezer recycling from the 2013 TRM continue to be used in the 2014 TRM. The Commission also proposed to update the inputs to the algorithm with EDCs’ PY4 data to represent the most accurate kWh and kW savings specific to Pennsylvania.

1. **Comments**

PECO and PPL believe that the kWh and kW savings of a recycled refrigerator or freezer that is replaced with a new unit should be determined using the U.S. DOE UMP methodology for program-induced replacement and not the method adopted in the 2013 TRM. PPL states that using the UMP to determine the replacement rate is consistent with the other aspects of the TRM protocol that follow the U.S. DOE UMP.[[201]](#footnote-201)

PECO also comments that the protocol improperly includes deemed savings values based on net savings rather than gross savings as is used on all other measures in the TRM. Also, PECO believes that evaluators should account for replacement units only when a recycling program induces replacement. PECO requests a table of the deemed coefficients so that the EDCs can more easily incorporate the information into their tracking systems.[[202]](#footnote-202)

With regard to freezers, PECO notes that it is unclear where the coefficients for the Existing Freezer UEC algorithm were derived. A proper reference for the freezer algorithm and deemed coefficients should be provided.[[203]](#footnote-203) For the algorithm for Existing Refrigerator UEC, PECO recommends removing the average age of units recycled of 27.036. Regarding labeling, PECO and FirstEnergy suggest several changes. PennFuture/KEEA requests that clarity and consistency be provided regarding the derivation of replaced kWh in Tables 2-48 and 2-49 and the text discussion on page 107.[[204]](#footnote-204)

1. **Disposition**

The Commission adopts the U.S. DOE UMP methodology for calculating deemed gross savings for refrigerators and freezers that are removed and not replaced. In the 2013 TRM Order, the Commission adopted an adjustment to savings when a refrigerator or freezer is removed and then replaced with a new unit.[[205]](#footnote-205) The 2013 TRM Order explained in detail the basis for the Commission’s decision to adjust savings when a removed refrigerator or freezer is replaced with a new unit. The Commission reaffirms this decision and declines to adopt, at this time, the Induced Replacement Rate that is included in the U.S. DOE UMP.

Regarding the usage of coefficients, the U.S. DOE UMP states that “While differences exist between the evaluation approach for each appliance type (for example, all stand-alone freezers are secondary units, while refrigerators may be primary or secondary units), this protocol can also be used to evaluate the savings for freezers.”[[206]](#footnote-206)

The TRM has been updated to provide a table of deemed coefficients for these protocols so that the EDCs can more easily incorporate them into their tracking systems. Additionally, documentation has been provided for the coefficients for the Existing Freezer UEC algorithm. We agree with PECO regarding the Existing Refrigerator UEC and have modified the algorithm to remove the average age of units recycled of 27.036. The Commission has also made the labeling changes requested by PECO and FirstEnergy.

1. **Electroluminescent and LED Nightlights**

These measures did not receive substantial updates in the proposed 2014 TRM. However, several parties provided recommendations on updating these measures which are discussed below.

1. **Comments**

FirstEnergy, PPL and PECO note that the ISR for both the Electroluminescent Nightlight and the LED Nightlight protocols should provide both a default value and an option for EDC Data Gathering. For the default ISR value, PPL recommends that the Commission use the ISR for CFLs. PECO, however, comments that there is no indication that the ISR for nightlights is as high as the ISR for CFLs. In the absence of better data, PECO recommends a default ISR of between 60% and 85% using professional judgment to make this estimate. FirstEnergy recommends that the Commission consider merging the Nightlight sections.[[207]](#footnote-207)

PECO also comments that the baseline wattage for the Electroluminescent Nightlight should be an open variable allowing EDC data gathering. PECO states that this is particularly important for direct install, giveaway and efficiency kit measures where the nightlights may be installed in locations that previously had no nightlight. It is also possible that these will be replacing LED rather than incandescent nightlights.[[208]](#footnote-208)

1. **Disposition**

The Commission accepts the recommendation of FirstEnergy, PPL and PECO to provide a default ISR, as well as an option for EDC Data Gathering. The Commission agrees with PPL’s suggestion that the default ISR should be consistent with the ISR for CFL bulbs. The Commission agrees with PECO that there is no indication that these ISRs are consistent; however in the absence of better data, the Commission feels the most reliable ISR comes from the U.S. DOE UMP for CFLs. Because this will be an open variable, PECO may use a different ISR if evaluation findings reveal a value that differs from the default. The Commission also accepts PECO’s recommendation that the baseline wattage for Electroluminescent Nightlights be modified to include an option for EDC Data Gathering. However, the Commission will still include a default value for the baseline wattage for those EDCs that do not wish to gather this data.

The Commission rejects FirstEnergy’s recommendation to combine the two nightlight sections as there are key differences between the two measures and combining them may cause confusion.

1. **Holiday Lights**

The Holiday Lights measure protocol was not discussed in the Tentative Order. However, comments were received on this protocol and are discussed below.

1. **Comments**

PennFuture/KEEA recommends that this measure be eliminated because LED Holiday Lights have saturated the market and no longer require EDC support.[[209]](#footnote-209)

1. **Disposition**

At this time, the Commission will retain this measure in the TRM as there is no definitive proof that the market is saturated for LED Holiday Lights. However, the Commission directs the PEG to monitor this issue and provide recommendations during future TRM updates.

1. **ENERGY STAR Window**

The ENERGY STAR Window measure protocol was not discussed in the Tentative Order. However, comments were received on this measure and are discussed below.

1. **Comments**

PennFuture/KEEA comments that the savings protocol is neither well-developed nor well-documented for residential ENERGY STAR windows. There is no information on assumed heating and cooling efficiencies in the protocol, nor on the baseline and high efficiency glass U-values. Further, PennFuture/KEEA states that there is no consideration of improved solar heat gain coefficient (SHGC) impacts on cooling.[[210]](#footnote-210)

1. **Disposition**

Due to a lack of information, the Commission directs the PEG to review the comments from PennFuture/KEEA and provide recommendations in future TRM updates.

1. **Fuel Switching: Electric Heat to Gas, Propane and Oil Heat**

This measure was not discussed in the Tentative Order. However, comments were received on this measure and are discussed below.

1. **Comments**

PECO suggest that, in addition to the most up-to-date ENERGY STAR requirement, older models that met a previous ENERGY STAR metric be acceptable with a sunset date. Additionally, PECO requests that appliances without an ENERGY STAR label but meeting current ENERGY STAR requirements be accepted. PECO also recommends language changes to the opening paragraph or in section 2.19.1 of this measure. PECO and PPL note that the two equations in Section 2.19.1 use EFLHelec and EFLHheat incorrectly. Additionally, EFLHheat is not defined in Section 2.19.2.[[211]](#footnote-211)

PPL recommends replacing all instances of “gas” and “natural gas” with “fossil fuel” to reflect the expanded eligibility of those fuel types. PPL notes that the subtraction of the fan motor for the furnace/boiler in the second equation is unnecessary as the ASHP has a fan as well.[[212]](#footnote-212)

1. **Disposition**

The Commission agrees with PECO that older ENERGY STAR units should be given a sunset date. Additionally, the Commission will allow the EDCs to provide incentives for equipment with efficiencies greater than or equal to the applicable ENERGY STAR requirement. The Commission will also allow products meeting the ENERGY STAR criteria to be incentivized, even if they are not ENERGY STAR-labeled. However, product qualification must be confirmed through a review of the AHRI testing reports.

The Commission accepts PECO’s suggestion to allow billing analysis data, when available, in lieu of the defaults provided in this measure protocol. The Commission also agrees with PPL and PECO that the EFLH associated with the furnace/boiler in both equations is misnamed and should use a common term that is broad enough to include the available options of gas, propane and oil. We have accepted PECO’s suggested changes and updated the equations accordingly. The Commission, however, rejects PPL’s recommendation to remove the furnace/boiler fan motor term in the kWh savings of a fuel heater over ASHP because the fan motor contribution of the ASHP is included in the HSPF term.

1. **Residential Behavior-Based Programs**

The Residential Behavior-Based Programs were not discussed in the Tentative Order. However, comments were received regarding this protocol and are addressed below.

1. **Comments**

PennFuture/KEEA comments that there is no O-Power-type behavioral program characterization or protocol in the TRM, even if only to specify the protocol by which a contractor would develop their savings estimates. In aggregate, annual, though probably not lifetime, savings potential from behavioral program activities could be second only to lighting in their contribution to residential sector savings. PennFuture/KEEA also states that, if the EDCs plan to add such programs to their residential portfolios in 2014, then the TRM should provide some guidance as to measuring and reporting program savings and regarding measure lives.[[213]](#footnote-213)

1. **Disposition**

The Commission notes that the SWE and the EDCs developed an MMP for residential behavior-based programs during Phase I. The Commission approves the use of this MMP for these programs in Phase II, as well. The Commission also directs the PEG to examine the U.S. DOE UMP now under development for behavior-based programs to determine if this forthcoming protocol should be used in the future for determining savings from such programs.

1. **Home Performance With ENERGY STAR**

The Home Performance with ENERGY STAR measure protocol was not discussed in the Tentative Order. However, comments were received regarding this protocol and are addressed below.

1. **Comments**

PECO believes that building simulation models typically only calculate non-coincident peak demand savings and, as such, a peak demand savings algorithm needs to be specified. PECO and PennFuture/KEEA comment that detailed and opinionated information about a particular company’s proprietary software product is not necessary or appropriate for inclusion in a TRM protocol. PennFuture/KEEA also comments that there is currently no context or discussion as to the proper modeling of homes in Pennsylvania’s Home Performance Program.[[214]](#footnote-214)

1. **Disposition**

The Commission directs the PEG to review the protocol and provide recommendations, in future TRM updates, on a more general summary of building simulation software options, perhaps with additional guidance on proper modeling of homes in Pennsylvania’s Home Performance Program. The Commission also directs the PEG to develop an appropriate peak demand reduction algorithm for demand reduction outputs from building simulation software models to be included in the 2015 TRM update.

1. **Duct Sealing (New Measure)**

In its Tentative Order, the Commission proposed the addition of a new protocol for duct sealing. The Commission received comments from several parties and addresses those comments below

1. **Comments**

PECO believes that the section provides no guidance on how to evaluate savings from duct insulation in the case of the modified blower door subtraction method and that either guidance should be added to this method or the title/scope of the measure should be changed. PennFuture/KEEA comments that the Building Performance Institute’s (BPI) Look-up Table Method is somewhat subjective and imprecise and should not be allowed. They suggest the use of other approaches, such as use of a blower door and a duct blaster, which are commonly used but not recognized in the TRM. PPL requests that the Commission clarify the correct measure life.[[215]](#footnote-215)

1. **Disposition**

The TRM has been modified to remove duct insulation from the scope/title of the measure. The Commission directs the PEG to consider adding guidance on duct insulation to Method 1: Modified Blower Door Subtraction and provide recommendations during future TRM updates. The TRM has been amended to correct the measure life in Appendix A from 14 years to 20 years for duct sealing.

The Commission rejects PennFuture/KEEA’s recommendation to eliminate the BPI Look-up Table method as this approach, although somewhat subjective, does provide a reasonable approximation of duct leakage in situations in which a blower door is not available and is an accepted alternative to the Modified Blower Door Subtraction method in other TRMs, including the Illinois Statewide TRM. The Commission notes that Modified Blower Door Subtraction is described as the preferred approach in the TRM. The Commission does, however, direct the PEG to research whether other options should be included as alternative methods for determining duct sealing savings and provide recommendations during future TRM updates.

1. **Commercial and Industrial EE&C Measure Protocols and Processes**
   1. **Lighting Protocols**
2. **Linear Fluorescent Lighting**

The Energy Policy Act of 2005 (EPAct)[[216]](#footnote-216) introduced new efficiency standards for linear fluorescent bulbs and ballasts, effectively phasing out magnetic ballasts on October 1, 2010 and T-12 bulbs on July 14, 2012. In the 2013 TRM Final Order,[[217]](#footnote-217) the Commission directed the PEG to investigate the impacts of these new lighting standards and recommend future adjustments to the TRM when necessary.

In the Tentative Order, the Commission proposed that the baseline for a lighting retrofit project continue to be the existing lighting system for the entirety of Phase II. After reviewing approaches by other jurisdictions, the Commission believes that the assumptions made by the 2012 Illinois TRM[[218]](#footnote-218) are reasonable and proposes that the same methodology be used in future TRM updates to account for new code changes.

The Commission clarified that its proposal regarding these new code standards would not impact the EDCs’ first year savings that are used to determine EDC compliance. These changes, however, appear to affect the TRC Test valuation for T-12 replacements as the energy savings and useful life are reduced each year due to the changing lighting baseline values as such lighting becomes unavailable. The Commission proposed to include a methodology to calculate lifetime savings for linear fluorescent measures that replace T-12s in PY6 and PY7.[[219]](#footnote-219) The Commission proposed that standard T-8s become the baseline for all T-12 linear fluorescent retrofits beginning June 1, 2016, should the Commission implement a Phase III of the Act 129 EE&C Program. Therefore, measures installed in PY6 and PY7 will claim full savings until June 1, 2016. Savings adjustment factors would be applied to the full savings for savings starting June 1, 2016, and for the remainder of the measure life. In TRC Test calculations, the EDCs may adjust lifetime savings either by applying savings adjustment factors or by reducing the effective useful life[[220]](#footnote-220) (EUL) to adjust lifetime savings. The Commission proposed savings adjustment factors and reduced EULs for HPT-8 and T-5 measures.

In addition, the Commission noted that the SWE is planning to collect T-12 storage and expected improvement strategies of customers during the Phase II C&I Baseline Study[[221]](#footnote-221) and the Phase II Lighting Metering Study. As such, the Commission proposed that these new code standards be reviewed during future TRM updates in order to incorporate the findings from these statewide studies, as well as research studies conducted in other jurisdictions.

1. **Comments**

PennFuture/KEEA supports the Commission’s treatment of the baseline shift for retrofit measures and the methodology used in developing the savings adjustment factors and adjusted effective useful lives in calculating lifetime savings for linear fluorescent measures that replace T-12s. It notes that the TRM for PY7 should see a corresponding decrease in the savings adjustment factors and adjusted effective useful life. PennFuture/KEEA also states that, because first year savings are unaffected, T-12 retrofits may be overvalued as compared to other lighting measures with lower first-year savings but greater lifetime savings. FirstEnergy replies that such topics are addressed through existing TRM treatment, combined with net-to-gross assessments, or are otherwise addressed in the implementation of the TRM and that PennFuture/KEEA’s recommendations be rejected.[[222]](#footnote-222)

PennFuture/KEEA states that there are additional technologies for which a baseline adjustment may be appropriate. PennFuture/KEEA also notes that Appendix C includes some technologies that may be considered an efficient upgrade from the baseline while others may, themselves, be considered the baseline. PennFuture/KEEA also notes that the Prescriptive Lighting Table included in Appendix C, the lighting tool, provides savings values for retrofitting existing T-12 fixtures with standard efficiency T-8s. PennFuture/KEEA asserts that this is a sub-optimal technology selection. PennFuture/KEEA recommends that the Commission ensure that the savings algorithms and the directives in Appendix C do not promot measures that are sub-optimal.[[223]](#footnote-223)

PennFuture/KEEA also notes that Appendix A of the TRM provides only a single measure life value for C&I non-solid state lighting measures. It asserts that this is not sufficient to address the variety of lighting technologies that are otherwise covered by the TRM, nor does it address those technologies and retrofit situations, other than linear fluorescent retrofits, where a baseline shift may be appropriate. PennFuture/KEEA recommends including savings adjustment factors for other retrofit measures that should account for a baseline shift in the next few years.[[224]](#footnote-224)

PennFuture/KEEA comments that LED traffic lights are the baseline and that for retrofits, LED traffic lights are likely to have a very high level of free-ridership. PennFuture/KEEA suggests that these fixtures should be omitted from the TRM.[[225]](#footnote-225)

1. **Disposition**

The Commission rejects PennFuture/KEEA’s comments regarding how T-12s are valued. The Commission agrees with FirstEnergy’s comments that such topics are addressed through existing TRM treatment, combined with net-to-gross assessments, and the implementation of the TRM.

The Commission acknowledges PennFuture/KEEA’s comments that Appendix C contains some lighting technologies that are no longer offered. However, due to the phasing in of the EISA standards, the Commission will retain those technologies in Appendix C, at this time. However, the Commission directs the PEG to review those technologies and their appropriateness for inclusion during future TRM updates.

The Commission notes that many of the changes proposed by PennFuture/KEEA, including adding savings adjustment factors for other lighting technologies to account for a baseline shift in the next few years and excluding LED traffic lighting measures from the TRM, cannot be made without detailed investigation and consideration. The Commission, therefore, directs that these proposed changes be considered by the PEG and recommendations provided during future TRM updates.

1. **Peak Demand Savings for Lighting Control Improvements**

The C&I lighting protocol in the 2013 TRM was constructed in such a way to account for energy savings only for lighting control retrofits. The savings algorithms did not account for peak demand savings. In the Tentative Order, the Commission proposed to modify the savings algorithms to allow the EDCs to claim peak demand savings for lighting control retrofits in addition to the energy savings. The Commission also proposed to include separate savings algorithms for fixture improvements and control improvements to make it easier to utilize.

1. **Comments**

PECO supports the separation of savings calculations between fixture retrofits and control retrofits. However, it notes that there are some fixture retrofits that are done on systems that already have controls installed and that there is no way to make an adjustment to the lighting HOU in the algorithm and suggests revisions.[[226]](#footnote-226)

1. **Disposition**

The Commission recognizes the need to update the algorithms for “all fixture improvements” measures to accurately represent savings. The Commission also agrees with PECO that there could be fixture retrofits that are done on systems that already have controls installed and that the existing algorithms do not account for this. The Commission has therefore updated the algorithms.

1. **Usage Groups and Hours of Use Values**

In the Tentative Order, the Commission proposed to clarify the language in the TRM regarding when the usage groups should be considered and how to determine the HOU for lighting projects. In addition, separate thresholds and sections were proposed in order to clarify when usage groups should be used and when metering should be conducted.

1. **Comments**

PECO suggests clarifying the intended purpose where reference to “metering” is made to avoid any confusion. PECO states that in this context it appears to mean the logging of run hours only. PECO also notes that the allowed methods of quantifying annual hours of operation for connected load savings of 20 kW or more in Section 3.2.6 mention BMS data as a possible source of information. Regarding the Metering section, for projects with savings of >=500,000 kWh, PECO notes that, if BMS data is to be used in lieu of metering, care should be taken since the programmed schedule may not reflect regular hours, long unscheduled overrides of the lighting system or how the lights were actually used. Additionally, PECO states that BMS trends should represent the actual status of the lights, not just the command sent to the lights, and that the CSPs or evaluators should be required to demonstrate that the BMS is functioning as expected, prior to relying on its data for evaluation purposes. Lastly, PECO recommends that the BMS data utilized should be specific to the lighting systems and should be required to be representative of the building areas included in the lighting project.[[227]](#footnote-227)

Duquesne suggests clarifying the language in Section 3.2.6 to ensure that whole building HOU be used when appropriate and that it is permissible to use such whole building HOU where applicable to any specific building use area.[[228]](#footnote-228)

FirstEnergy states that the source for the majority of building types HOU and CFs in Table 3-6 is the outdated Version 2.0 of the Mid-Atlantic TRM,[[229]](#footnote-229) released in July of 2011. FirstEnergy notes that Version 3.0 of the Mid-Atlantic TRM[[230]](#footnote-230) was published in March of 2013 and recommends modifying Table 3-6 values to reflect the more current HOU and CF values from Version 3.0. Second, FirstEnergy notes that the building type categories listed in the TRM vary among technologies. FirstEnergy suggests that the Commission direct the PEG to assess the viability of aligning building types across technologies in the TRM to enhance consistency in documentation and streamline tracking and reporting processes.[[231]](#footnote-231)

Third, FirstEnergy states that the TRM includes a new provision for projects with connected load savings less than 20 kW and where whole facility lighting projects where the facility’s actual lighting hours deviates by more than 10% from Table 3-4 hours for the appropriate building type. FirstEnergy believes that, while the application of an “other” category for such cases is at the discretion of the EDC’s CSPs and evaluators, it is an impractical choice for small projects. FirstEnergy further asserts that, if there are tables of deemed hours, then it makes sense to use those tables categorically, when applicable. FirstEnergy suggests that the projects with connected load savings less than 20 kW should use deemed hours unless they are in the “other” category. Lastly, FirstEnergy notes that revisions or guidance is needed to resolve conflicting thresholds mentioned elsewhere in the TRM compared to the >=500,000 kWh thresholds established for the non-residential lighting end-use category.[[232]](#footnote-232)

PPL comments that there are conflicting requirements related to the usage groups between Section 3.2.7 and Appendix E (New Construction Lighting Savings Tool), and between Section 3.2.7 and general industry practice for new construction lighting. PPL recommends language changes to Section 3.2.7. PPL points out that Section 3.2.6 requires usage groups for any project with a change in connected load greater than 20 kW. PPL states that a “change in connected load” is a concept applicable to lighting retrofits where there is a difference between the connected load of the original lighting and the connected load of the efficient lighting. However, for new construction lighting, savings are based on the difference in lighting density between the efficient lighting and code requirements. In addition, PPL avers that industry practice is to use the ASHRAE Whole Building Method and that lighting contractors do not use “usage groups” in their software packages to determine HOU.[[233]](#footnote-233)

PPL also asserts that requiring usage groups for Act 129 new construction lighting would discourage participation in the program or force lighting trade allies to change their established practices and software. PPL further points out that Appendix E does not include the capability to establish usage groups and will require significant revision.[[234]](#footnote-234)

1. **Disposition**

Regarding PECO’s suggestion to clarify the intended purpose where reference to “metering” is made, the Commission notes that the assumptions tables in the measure-specific protocols clearly state which variables are subjected to metering (logging) requirements. The Commission further notes that similar clarifications are provided throughout the TRM, where appropriate, to avoid any confusion.

The Commissions recognizes the need for more clarity in the TRM regarding the use of BMS data as a possible source of information to accurately calculate savings. The Commission agrees with PECO and has incorporated its recommendations into the TRM.

The Commission rejects Duquesne’s request to allow the use of the whole building HOU in Table 3-6 for any specific building use area, where applicable. The Commission believes that it is inappropriate to mix HOU values from the different building types in Table 3-6 and apply those to different usage groups within the same facility. Table 3-6 represents a blended annual lighting HOU for all usage groups within a particular building type. The Commission, therefore, believes that it would be a misapplication of Table 3-6 to use, for example, Office and Warehouse whole building HOU for different usage groups in a distributed warehouse. The Commission also clarifies that the changes in this section were largely based on the findings from evaluations during Phase I and the informal feedback received from the EDCs.

The Commission acknowledges FirstEnergy’s comments regarding using the latest available Mid-Atlantic TRM version to update the list of building types, HOU and CF values. The Commission reviewed the Mid-Atlantic TRM Version 3.0 and all the sources used to develop the HOU and CF estimates and assessed the need to update Table 3-6. The Commission believes that the source used in the latest Mid-Atlantic TRM is more appropriate to Pennsylvania, which will result in significant improvement over the existing HOU and CF values. However, we believe this issue should be discussed further by the PEG before inclusion in the TRM to ensure their appropriateness and feasibility. The Commission believes that updating the list of building types, HOU and CF values will require significant revisions to the algorithms and to Appendix C. Such modifications will require the EDCs to update tracking systems, rebate application forms, and other processes and may potentially confuse customers. Therefore, the Commission directs the PEG to discuss this issue and provide recommendations during future TRM updates.

The Commission clarifies that the 2014 TRM allows the EDCs to use customer-specific data to determine HOU and CF values, where appropriate. The default values in Table 3-6 may be supplemented by facility staff interviews, posted schedules, BMS or metered data as per the guidance provided in the TRM.

The Commission recognizes the need to standardize the list of building types and align them across all the measures/technologies included in the TRM; however, we believe this will take significant review. As such, we direct the PEG to review the building types in the 2014 TRM and provide a way to align them across measures/technologies for inclusion in the 2015 TRM update.

In response to FirstEnergy’s comments regarding the use of default values from Table 3-6 for lighting projects with connected load savings less than 20 kW, the Commission clarifies that, for whole facility lighting projects where the facility’s actual lighting hours deviate by more than 10% from the Table 3-4 hours for the appropriate building type, the “other” category may be used at the discretion of the CSPs and evaluators. The Commission notes that, if this option is chosen, the CSPs and evaluators should apply this methodology consistently throughout a program year for all projects to which it pertains. While the Commission agrees with FirstEnergy that it is reasonable to apply default values for such small lighting projects unless they are in the “other” category, we believe that the EDCs should be given the flexibility to use customer-specific information, if available.

The Commission disagrees with FirstEnergy’s comments that a conflict exists when the thresholds are compared to the >=500,000 kWh thresholds established for the non-residential lighting end-use category. The Commission believes that the TRM clearly specifies under which circumstances a detailed lighting inventory form (Appendix C) is required, usage groups should be considered, the different data collection methods allowed and how to calculate the savings.

The Commission rejects PPL’s proposed language changes for Section 3.2.7. While the Commission agrees with PPL that savings for new construction lighting projects are based on the difference in lighting power densities between the efficient lighting and code requirements and that usually the ASHRAE whole building method is used, we believe that the EDCs should be given the flexibility to use the usage groups if they wish to do so. The Commission clarifies that the EDCs have discretion to use the whole building method or the space-by-space method for calculating savings.

The Commission also clarifies that Appendix E does have the capability to use the space-by-space method where usage groups may be populated if required. The Commission further notes significant revisions were made to Appendix E to improve its reasonableness and make it consistent with the TRM. These changes are discussed in detail in the Appendix E section of this Order.

* 1. **Premium Efficiency Motors and Variable Frequency Drive Improvements**

1. **Operating Hours, Energy Savings Factors and Demand Savings Factors**

The motor operating hours in Table 3-15 for the Motor measure and ESF and DSF values in Table 3-17 for the variable frequency drive (VFD) measures in the 2013 TRM were adopted from the 2012 Connecticut TRM.[[235]](#footnote-235) As with the EFLH values for HVAC measures, the SWE ran computer simulation models to determine the motor operating hours, ESF and DSF values for motor and VFD protocols using eQUEST[[236]](#footnote-236) software for the 2014 TRM update. The Commission proposed using the existing motor operating hours and ESF and DSF values in the 2013 TRM for the 2014 TRM until more accurate information became available. The Commission also recommended that the SWE run computer simulation models to determine motor operating hours and ESF and DSF values for motors and VFD measures using eQUEST software for various building types across each climate zone in Pennsylvania for future TRM updates. Lastly, the Commission suggested that the SWE compare the results from the Phase II C&I Baseline Study with Phase I C&I Baseline Study[[237]](#footnote-237) findings and make improvements to the models to develop the most accurate Pennsylvania-specific values.

1. **Comments**

PennFuture/KEEA states that the stipulated motor operating hours in Table 3-17 are inconsistent. Specifically, PennFuture/KEEA points out that the HOU for heating pumps are constant regardless of building type, but ventilation and cooling vary considerably. PennFuture/KEEA further states that the heating HOU are surprisingly high and should be revisited and updated, particularly those for heating, if necessary.[[238]](#footnote-238)

1. **Disposition**

The Commission recognizes that there are some data inconsistencies in the existing motor operating hours in Table 3-17 and the need to update these values. The Commission clarifies that the SWE is currently doing eQUEST modeling to update these values, which will be available for the 2015 TRM update. As such, the EDCs should use those values included in the 2014 TRM and provide feedback, through the PEG, regarding the Table 3-17 inconsistencies during the 2015 TRM update.

1. **Motor Baselines**

The Tentative Order did not discuss the baselines for premium efficiency motors measure protocol. However, comments were received and are addressed below.

1. **Comments**

FirstEnergy and PPL state that the provisions, standards and references applicable to PY1, PY2, PY3 and PY4 in Tables 3-14 and 3-15 should be clarified for their applicability to 2014 and beyond.[[239]](#footnote-239)

PennFuture/KEEA states that recent changes in federal minimum standards for motor efficiency have created the need to address a baseline shift. PennFuture/KEEA also notes that the TRM sets the baseline efficiency of an early replacement motor at nameplate rating, but provides no guidance for determining the point at which the motor would have reached the end of its useful life. This affects the calculation of cost-effectiveness.[[240]](#footnote-240)

1. **Disposition**

The Commission recognizes the need for more clarity regarding the applicability of Tables 3-15 and 3-16 in Phase II to determine the motor baselines for calculating savings. As such, the Commission clarifies that Table 3-15, which shows motor baselines based on NEMA EPAct efficiency motor standards, is no longer applicable to Phase II. Table 3-16, which shows motor baselines based on NEMA premium efficiency motor standards, is applicable to all program years during Phase II. The Commission, therefore, has removed Table 3-15 and revised the TRM accordingly.

The Commission acknowledges PennFuture/KEEA’s comments regarding the recent changes in federal minimum standards for motor efficiency and the need to address a baseline shift. Specifically, the Commission notes that EISA restates the definition of General Purpose Electric Motors and classifies them as Subtype I or Subtype II. EISA impacts not only the required efficiency standards for Subtype I electric motors, it creates a new designation of General Purpose Electric Motors (Subtype II) that was not covered by EPAct. The Commission, therefore, added separate tables in the TRM with baseline efficiencies for Subtypes I and II in order to accurately calculate savings. The Commission further notes that the tables and formulas in Appendix D have been updated to be consistent with the TRM.

The Commission also acknowledges PennFuture/KEEA’s comments that the TRM provides no guidance for determining the point at which the motor would have reached the end of its useful life and, therefore, been replaced with a motor meeting the current standard. The Commission agrees with PennFuture/KEEA’s recommendation and directs the PEG to review this issue and provide recommendations during future TRM updates.

1. **Coincidence Factor and Load Factor Assumptions**

The Tentative Order did not discuss the CF and Load Factor assumptions for premium efficiency motors measure protocol. However, comments were received regarding the assumptions and are addressed below.

1. **Comments**

PennFuture/KEEA states that the default load factor and CF measure assumptions were adopted from California Database for Energy Efficient Resources (DEER 2005),[[241]](#footnote-241) but no information was provided to determine if there are any differences in peak period definitions between California and Pennsylvania, or whether the peak period in California has remained the same since 2005. PennFuture/KEEA recommends that the load factor and CF data from California be updated and demonstrated to be valid for Pennsylvania. PennFuture/KEEA states that the characterization only provides one CF, regardless of which mechanical system the motor serves. FirstEnergy believes that PennFuture/KEEA’s comments could be implemented on a near-term basis without significantly affecting the current, Commission-approved EE&C Plans.[[242]](#footnote-242)

1. **Disposition**

The Commission clarifies that the default CF and load factor assumptions are adopted from DEER 2005, which uses a peak demand period of 12:00 p.m. to 6:00 p.m., weekdays, May through October. The Commission agrees with PennFuture/KEEA that the CF value adopted from DEER 2005 is likely not the best proxy to use in lieu of actual Pennsylvania data. The Commission recognizes the need to update the load factor and CF assumptions to reflect the new peak demand period in Pennsylvania. As discussed in the Coincidence Factors section of this Order, the Commission believes that hourly load profiles should be developed to determine the CF. However, this task will require rigorous review. The Commission, therefore, directs that the PEG review these issues and provide recommendations for future TRM updates.

The Commission acknowledges PennFuture/KEEA’s comments that the measure protocol only provides one CF value regardless of which mechanical system the motor serves. The Commission also recognizes the need to develop separate CF values for each of the building types given the wide range of operating hours by building type and motor function. The Commission clarifies that the SWE is already evaluating the feasibility and appropriateness of such values and will provide recommendations for future TRM updates based on the results obtained from eQUEST modeling.

1. **VFDs End-Use Category kWh Thresholds**

Section 3.4.4 describes situations in which the EDCs are required to collect customer-specific information for calculating *ex-ante* and/or *ex-post* savings.

1. **Comments**

FirstEnergy recommends removing both thresholds in Section 3.4. Specifically, FirstEnergy suggests dropping the reference to 25,000 kWh savings threshold for metering VFDs when a project uses the “Other” category. FirstEnergy notes that, given the increased focus on metering, this requirement is no longer needed. FirstEnergy states that, in most cases, the larger projects will be metered, while in some cases simulations or other modes of data collection will suffice. PennFuture/KEEA replies that the requirements for VFD metering is appropriate given the possible large variability in operating hours and profile, particularly for those building types classified as “Other.”[[243]](#footnote-243)

1. **Disposition**

The Commission rejects FirstEnergy’s recommendation to remove both thresholds from Section 3.4. The Commission agrees with PennFuture/KEEA’s request to maintain the thresholds for motors & VFDs end-use category as the thresholds are appropriate given the large amount of savings and variability in operating hours.

* 1. **Variable Frequency Drive Improvement for Industrial Air Compressors**

This measure was not discussed in the Tentative Order. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO notes that compressed air system electrical use is highly variable. PECO suggests providing additional information for determining when the measure protocol should be considered as a prescriptive measure. Specifically, PECO recommends including information related to the assumed range of HP applicable for the referenced stipulated savings factors, the operating pounds per square inch (PSI) assumed, the assumed baseline compressor control type, and typical hours of operation used to derive the stipulated savings factors, actual load factors, and other supporting documentation from recognized industry sources. PECO further suggests that, if this type of information is not available, the Commission should consider making this a custom measure until the appropriate research can be performed. PECO also comments that the peak demand algorithm includes both a DSF and CF and it is unclear from the original source document whether or not the CF is already included in the DSF.[[244]](#footnote-244)

* + - 1. **Disposition**

Based on our review of PECO’s comments regarding the use of the latest industry research and from research the SWE did on the procedures used by other jurisdictions, the Commission has chosen to remove this protocol from the TRM. Instead, it will be considered a custom measure.

* 1. **HVAC Systems**

1. **Heating and Cooling Equivalent Full Load Hours**

The 2013 TRM calculates EFLH for HVAC measures by adjusting EFLH values reported in the Connecticut Program Savings Documentation[[245]](#footnote-245) using full load hours from the U.S. DOE ENERGY STAR calculator[[246]](#footnote-246) based on a degree-day scaling methodology. However, the SWE ran computer simulation models to determine EFLH values for HVAC measures using eQUEST[[247]](#footnote-247) software for the 2014 TRM update. This exercise showed that the EFLH values derived from the eQUEST modeling may not provide any improvement over the methodology used in the 2013 TRM due to some uncertainties in data inputs. The Commission, therefore, proposed to use the existing EFLH values in the 2013 TRM for the 2014 TRM until more accurate information is available. The Commission proposed that the SWE run computer simulation models to determine EFLH values for HVAC measures using eQUEST software for various building types across each climate zone in Pennsylvania for future TRM updates. The Commission proposed that the SWE compare the results from the Phase II C&I Baseline Study with the PA C&I Baseline Study findings and make improvements to the models to develop the most accurate Pennsylvania-specific EFLH values.

In addition, Commission found some inconsistencies in the heating EFLH values for heat pump measures for several building types in Table 3-22, Section 3.6. The Commission believes these errors were due to changes not being transferred correctly between documents and/or data inconsistencies in previously used secondary sources. To ensure consistency, the Commission proposed to update the heating EFLH values for some cities and/or building types in the TRM by adjusting EFLH values reported in the Connecticut Program Savings Documentation[[248]](#footnote-248) using full load hours from the U.S. DOE ENERGY STAR Calculator based on a degree-day scaling methodology.

1. **Comments**

PECO states that the heating EFLH have been reduced to 259 hours for Multi-Family (Common Areas) (as well as Hospitals/Health care and Police/Fire Stations). PECO notes that these values are very low and are equivalent to the heating systems being oversized by a factor of 5 or more. PECO suggests verifying that the modified EFLH values are appropriate.[[249]](#footnote-249)

1. **Disposition**

The Commission confirms that the modified EFLH values are correct. Also, the Commission has corrected the inconsistencies in the heating EFLH values for heat pump measures for several building types in Table 3-22. The Commission further clarifies that the EFLH values in 2014 TRM will be revisited and updated, during the 2015 TRM update, based on the SWE’s eQUEST modeling.

1. **HVAC Baselines**

The Tentative Order did not discuss the baselines for the HVAC systems measure protocol. However, comments were received and are addressed below.

1. **Comments**

PECO recommends revising algorithms for ΔkWh such that part load efficiency values can be used for larger units. In support of its request, PECO notes that Addendum S to ASHRAE 90.1-2007[[250]](#footnote-250) updates Tables 6.8.1A and 6.8.1B to include minimum integrated energy efficiency ratios (IEER) ratings for air, water and evaporatively-cooled air conditioners and air cooled heat pumps. PECO notes that, since most units are more efficient at part load capacity, this change will allow EDCs to claim the full kWh savings due to high efficiency cooling equipment.[[251]](#footnote-251)

1. **Disposition**

The Commission acknowledges PECO’s comments that ASHRAE 90.1-2007 updated the baselines for various HVAC systems to include IEER for larger units. The Commission has updated the baseline tables in the TRM to include minimum IEER ratings for air, water, evaporatively-cooled air conditioners and air cooled heat pumps where appropriate. The Commission further notes that IEER ratings are only applicable to equipment with capacity modulation. The Commission also agrees with PECO’s recommendation to revise savings algorithms to reflect changes to the baselines. However, we believe this task requires further review and directs the PEG to provide recommendations during future TRM updates.

1. **Coincidence Factors**

The Tentative Order did not discuss the CF assumptions for HVAC systems measure protocol. However, comments were received and are addressed below.

1. **Comments**

PECO comments that the existing CF value of 80% is based on an average CF for multiple other jurisdictions, which is very high compared with CFs found in the C&I Unitary HVAC Loadshape study completed by Northeast Energy Efficiency Partnerships (NEEP).[[252]](#footnote-252) PECO notes that the CFs based on the report are in the range of 44% to 63% for the Mid-Atlantic PJM hours. PECO asserts that the existing deemed value of the CF could substantially overstate the coincident demand savings for HVAC measures. PECO further comments that the current source is not appropriate for Pennsylvania as peak demand periods vary by jurisdiction. PECO recommends developing a proper load shape for HVAC systems in Pennsylvania and calculating the CF based on the new peak demand period.[[253]](#footnote-253)

1. **Disposition**

The Commission agrees with PECO that the existing average CF from multiple other jurisdictions is likely not the best proxy to use in lieu of actual Pennsylvania data. The Commission recognizes the need to update the CF assumptions to reflect the new peak demand period in Pennsylvania. The Commission further agrees with PECO that the existing CF value of 80% is very high compared with CFs found in the NEEP Study and could substantially overstate the coincident demand savings for HVAC measures. The Commission carefully reviewed this study and believes that the results from the study are more appropriate and relevant to Pennsylvania. As such, the Commission has updated the CF value to 55% for all unitary HVAC systems included in Section 3.6 of the TRM.

The study reports CF values in the range of 44% to 63% depending on the size of the unit for the Mid-Atlantic PJM hours. The study, therefore, assumes an average CF value of 55% for the Mid-Atlantic PJM hours that is applied to all units. The study used the installed cooling capacity to develop a small and large sampling dimension based on prior studies and experience that shows that larger units have different annual full load hours and peak coincidence timing. The units were also bifurcated into small and large based on the fact that large units (between 11.5 and 100 nominal tons cooling) have multiple compressors and fans that operate in stages, while a majority of small units (between 1 and 11.25 tons) are single stage units. The size cut point conforms to the ASHRAE 90.1 (2007) size class designations which set the minimum efficiency for new equipment based on nominal installed capacity range.

The Commission further agrees with PECO that hourly load profiles should be developed to determine the CF. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates.

* 1. **Electric Chillers**

The Tentative Order did not discuss the CF assumptions for Electric Chillers measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO comments that the existing CF value of 80% is based on an average CF for multiple other jurisdictions and is not an appropriate source for CF as peak demand periods vary by jurisdiction. PECO recommends developing a proper load shape for chillers in Pennsylvania and calculating the CF based on the new peak demand period.[[254]](#footnote-254)

* + - 1. **Disposition**

The Commission agrees with PECO that the existing average CF from multiple other jurisdictions is likely not the best proxy to use in lieu of actual Pennsylvania data. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates.

* 1. **High-Efficiency Refrigeration/Freezer Cases**

The Tentative Order did not discuss the CF assumptions for High Efficiency Refrigeration/Freezer Cases measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO states that the CF for the high-efficiency refrigeration/freezer cases measure protocol is set at 1.0; however, the reference source #2 is not included in the TRM. PECO further comments that a CF of 1.0 appears high for these units as the compressors do cycle as needed. PECO recommends developing a proper load shape for refrigeration cases for Pennsylvania and calculating the CF based on the new peak demand period.[[255]](#footnote-255)

* + - 1. **Disposition**

The Commission clarifies that the existing CF value was derived based on a load shape for commercial refrigeration equipment developed by DEER. The Commission agrees with PECO that a CF value of 1.0 appears high for this measure as the compressor only runs when needed. The Commission, therefore, recommends a CF value of 0.772 calculated from Itron eShapes, which is 8,760 hourly data by end use for Upstate New York.[[256]](#footnote-256)

* 1. **ENERGY STAR Office Equipment**

The Tentative Order did not discuss the ENERGY STAR Office Equipment measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO recommends updating the summer demand savings deemed values to represent the new peak demand period. PECO further notes that the source for CF indicates that the CF is already incorporated into summer demand savings deemed values in which case, a CF value of one, as stated in Table 3-46, is not appropriate. Therefore, PECO suggests removing the CF variable from the algorithm. In addition, PECO recommends developing a load shape for office electronics for Pennsylvania cities and calculating the CF based on the new peak demand period.[[257]](#footnote-257)

PennFuture/ KEEA notes that the deemed savings values for this measure protocol are based on a 2010 version of an ENERGY STAR savings calculator which does not appear to reflect the most recent version of the standard. Furthermore, PennFuture/KEEA states that the market share of ENERGY STAR office equipment is likely very high and the savings for these products are likely overstated.[[258]](#footnote-258)

* + - 1. **Disposition**

The Commission agrees with PECO’s suggestion to remove the CF variable from the demand savings algorithm since the CF is already incorporated into summer demand savings values. The Commission clarifies that the existing CF value for this measure was developed using a commercial office equipment load shape assuming that the top 100 system hours are most likely to occur between the hour of 2 PM and 6 PM, allowing for high coincidence with the office equipment usage. The Commission further clarifies that, if the load shape were completely flat, the peak demand savings would simply be energy savings divided by 8,760. However, because of the coincidence between the load shape and peak hours, the peak savings are greater than this value. The CF, defined as (kW \* 8760) / kWh, used for all office equipment is 1.18, as calculated by doing a covariance between the load shape and peak hours. The Commission has added language to the TRM to clarify the CF values.

The Commission agrees with PECO’s recommendation to update the summer demand savings deemed values to represent the new peak demand period. The Commission further agrees with PECO that hourly load profiles should be developed to determine the CF. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates.

Based on research performed by the SWE regarding ENERGY STAR calculators, the Commission clarifies that, although there is a more recent ENERGY STAR calculator available (published in December 2010), the deemed energy savings values are still the same compared to those currently in place. The Commission has updated the source to the latest available calculator. The Commission, however, notes that there is not sufficient data available to update the deemed savings values. The Commission acknowledges PennFuture/KEEA’s comments regarding the market share of ENERGY STAR office equipment. However, we believe that this topic requires further investigation and direct that the PEG review this issue and provide recommendations during future TRM updates.

* 1. **Smart Strip Plug Outlets**

The Tentative Order did not discuss the CF assumptions for Smart Strip Plug Outlets measure protocol. However, comments were received and are addressed below

* + - 1. **Comments**

PECO states that the CF value has not been updated to account for the new peak demand period. PECO recommends developing a proper load shape for office electronics for Pennsylvania and calculating the CF based on the new peak demand period.[[259]](#footnote-259)

* + - 1. **Disposition**

The Commission agrees with PECO’s recommendation to update the summer demand savings deemed values to represent the new peak demand period. The Commission further agrees with PECO that hourly load profiles should be developed to determine the CF. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates.

* 1. **High-Efficiency Ice Machines**

The Tentative Order did not discuss the CF assumptions for High-Efficiency Ice Machines measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO states that the CF value has not been updated to account for the new peak demand period. PECO recommends developing a proper load shape for ice machines for Pennsylvania and calculating the CF based on the new peak demand period.[[260]](#footnote-260)

* + - 1. **Disposition**

The Commission agrees with PECO’s recommendation to update the summer demand savings deemed values to represent the new peak demand period. The Commission further agrees with PECO that hourly load profiles should be developed to determine the CF. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates.

* 1. **Wall and Ceiling Insulation**

The Tentative Order did not discuss the baselines and CF assumptions for Wall and Ceiling Insulation measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO states that using cooling degree days (CDD) is an unreliable way to estimate cooling savings per the ASHRAE Handbook. PECO recommends using cooling degree hours as a more reliable method. PECO further comments that the EER and coefficient of performance (COP) have a high impact on the savings for this measure and that the defaults in the TRM are minimally code compliant. Specifically, PECO points out that for new construction and for heat pumps, the EERs available from manufacturers are often substantially higher than the minimally code compliant HVAC system efficiencies in the codes and standards, and higher EER options can be selected by engineering designers as standard practice. PECO recommends emphasizing that site-specific design values be used in the calculation wherever possible, to avoid overestimating the savings using the default minimally compliant EERs.[[261]](#footnote-261)

PECO states that the CF value has not been updated to account for the new peak demand period. In addition, PECO points out that the reference for EFLH and CF is outdated. Specifically, PECO notes that these values should reference a specific table or chart rather than just referencing a previous version of the TRM, which is no longer accurate. PECO recommends referencing Table 3-21 from Section 3.6 as the source for the CF. PECO also suggests that the CF value in Table 3-21 be updated based on the comments summarized for HVAC systems measure protocol in this Final Order.[[262]](#footnote-262)

PPL recommends using ASHRAE 90.1- 2007 as the reference for existing buildings in Table 3-56[[263]](#footnote-263) instead of ASHRAE 90.1- 2004. PPL notes that the 2007 version is currently in effect, supersedes 2004 and is referenced in other TRM protocols.[[264]](#footnote-264)

PennFuture/KEEA states that the reported baseline efficiencies are correct in that they accurately reflect the current Pennsylvania energy code (IECC 2009), but the current federal standards for PTACs and PTHPs, which took effect September 30, 2012, are now higher than the IECC 2009 requirements. PennFuture/KEEA recommends using the federal standard baseline rather than the IECC 2009 values for these types of equipment because federal standards dictate the equipment that can be manufactured and imported.[[265]](#footnote-265)

* + - 1. **Disposition**

Contrary to PECO’s comment, the ASHRAE Handbook does not state that the use of CDDs is “unreliable,” though it does mention that the use of cooling degree hours “better represent the period when equipment is operating than cooling degree-days” (F19.19). This assertion specifically relates to the difficulty of quantifying occupant behavior of using windows instead of air conditioning and building economizer control configurations, both of which are not automatically corrected by the blind use of cooling degree hours (such as CDH74 or CDH80) without adjustment. The Handbook suggests, rather than simply switching to cooling degree hours, using a variable base to account for variations in hourly or daily solar heat gain, internal loads, occupancy schedules, building set-points, and equipment efficiencies. To understand all of these values for each individual facility would be unreasonable for program implementation purposes.

The Commission agrees that, with careful adjustments and attention to detail, the cooling degree-hour metric has the potential to be more accurate due to greater granularity, but questions if overarching assumptions needed to allow this metric to be useful for the TRM would eliminate any actual accuracy gain over the current CDD metric. Having no other information from PECO, the Commission believes that the CDD methodology, which ASHRAE states is “appropriate if building use and HVAC equipment efficiency are constant,” is sufficient for this protocol. The Commission invites PECO (and other interested stakeholders) to provide greater clarity into the use of CDDs by preparing cooling degree hours for each region and providing evidence that the revised assumptions would present an accuracy gain during future TRM updates.

The Commission acknowledges PECO’s comment that code minimum efficiency levels should ideally not be the baseline specified unit as most designers at least consider higher efficient options, specifically for smaller tonnage units where higher efficiencies are more common. The Commission, however, believes that the designers always have the option to go with a code minimum efficiency unit so the baseline should remain unchanged at code minimum. The Commission recommends that the PEG discuss this issue further and provide recommendations during future TRM updates.

The Commission agrees with PECO’s suggestion to reference Table 3-21 from Section 3.6 as a source and to update the CF value. The Commission has also updated the CF value from 67% to 55% to reflect the changes made to Section 3.6 based on the feedback received from PECO.

The Commission accepts PPL’s recommendation to use ASHRAE 90.1- 2007 as the reference for existing buildings in Table 3-56 instead of ASHRAE 90.1- 2004. The Commission has also updated the baselines in the TRM to include minimum IEER ratings for air, water and evaporatively-cooled air conditioners and air cooled heat pumps, where appropriate, to reflect the changes made to Section 3.6 based on the Addendum S to ASHRAE 90.1-2007[[266]](#footnote-266) (Tables 6.8.1A and 6.8.1B).

The Commission acknowledges PennFuture/KEEA’s comments that the current federal standards for PTACs and PTHPs, which took effect September 30, 2012, are now higher than the Pennsylvania energy code IECC 2009 requirements. The Commission, however, rejects PennFuture/KEEA’s recommendation to use the federal standard baseline rather than the IECC 2009 values for these types of equipment. The Commission believes that updates to baselines cannot be made without rigorous review. Due to the complexity involved in this issue, the Commission refers this topic to the PEG for discussion and to provide recommendations during future TRM updates.

* 1. **Strip Curtains for Walk-In Freezers and Coolers**

In the Tentative Order, the Commission proposed to remove the factor of 60 in the equation used to calculate energy savings. The SWE reviewed the actual source documentation[[267]](#footnote-267) and savings calculation spreadsheet that was embedded in the original interim measure protocol document submitted to the SWE and realized that the equation contains an unnecessary factor of 60 for calculating deemed savings. The Commission noted that this update would not require any revisions to the deemed savings values in the protocol as the protocol reflects the accurate values.

* + - 1. **Comments**

PECO comments that it was unable to duplicate the savings that are represented in Table 3-58 of Section 3.17 using the equations and information provided in the Strip Curtains measure protocol. PECO questions whether or not there is a need to adjust either the equations or savings results to ensure that the calculations are correct. In addition, PECO recommends updating the algorithms to include all variables and other edits for more clarity.[[268]](#footnote-268)

PECO also notes that the term ETD (Average Usage Peak / Annual Energy Usage) is not used anywhere in the measure protocol and suggests removing it or adding it to the equations where appropriate. In addition, PECO states that the savings for warehouses reported in Table 3-58 are much higher than savings reported in the Commercial Facilities Contract Group 2006-2008 Direct Impact Evaluation California EM&V Report[[269]](#footnote-269) (EM&V Report) that is referenced several times in this measure protocol. PECO notes that the deemed savings for refrigerated warehouses in the TRM range from 254-728 kWh, whereas the savings in the EM&V Report are 177 kWh. PECO recommends justifying or adjusting the savings in the TRM to match measured data.[[270]](#footnote-270)

* + - 1. **Disposition**

The Commission accepts PECO’s recommendation to update the algorithms to include all variables and other suggested edits for more clarity. The Commission has also made a correction to the energy savings algorithm (savings per square foot by area) to accurately represent deemed savings values shown in Table 3-58 of Section 3.17.

The Commission further clarifies that the units for dry-bulb temperature of infiltrating air (Ti) and dry-bulb temperature of refrigerated air (Tr) used in the algorithms are in Rankine whereas the values in the assumptions tables are in Fahrenheit. The Commission has revised the definitions to avoid any confusion. The Commission agrees with PECO and has removed the term ETD (Average Usage Peak / Annual Energy Usage) as it is not utilized in the algorithms.

The Commission acknowledges PECO’s comments that savings for warehouses reported in Table 3-58 are much higher than savings reported in the EM&V Report. The Commission clarifies that the deemed savings values included in the TRM are based on the analysis prepared by ADM Associates, Inc., who also authored the EM&V Report. Based on the SWE’s review of deemed savings assumptions, methodologies and calculations from California, the values from Pennsylvania appear to be appropriate.

The Commission clarifies that the savings of 177 kWh shown in the EM&V Report are the verified savings for all strip curtains that were claimed to be installed in facilities described as refrigerated warehouses. The evaluator, however, found several issues that resulted in low realization rates despite the relatively high savings if the curtains are found to be installed in an actual warehouse. The main factor was the misclassification of buildings with different end-use descriptions as refrigerated warehouses. For example, the evaluator found that sometimes the facilities where the curtains were installed were not warehouses at all, and sometimes the strip curtain installations were not verified. The Commission, therefore, believes that the savings for strip curtains installed at an actual refrigerated warehouse should be much higher. To accurately estimate savings for this measure, the Commission further recommends that the EDCs use billing analysis for refrigerated warehouses for projects selected in the evaluation sample. This directive has been added to the TRM.

* 1. **Water Source and Geothermal Heat Pumps**

The Tentative Order did not discuss the baselines and CF assumptions for Water Source and Geothermal Heat Pumps measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO notes that, regarding the definitions of EER base and EEREE, in some cases, the heat pump EER variation with working fluid temperature is an essential aspect of the definition. PECO also states that, while it is true that, for new systems, the ratio of the baseline and efficient system EERs would likely be the same across a range of base and efficient source fluid temperatures, for projects where the baseline is an existing system running at a specific source temperatures, the project specific EERs based on the working temperatures could significantly impact the heat pump unit energy savings. PECO recommends revising the definitions of EER to reference the working temperature of the fluid in cases where an existing system is being replaced.[[271]](#footnote-271)

In addition, PECO notes that some unitary HVAC rating systems for EER include factors for auxiliary equipment. PECO states that, since pumping energy is correctly accounted for explicitly in the protocol, the Commission should consider clarifying the definition of base and efficient EERs such that, for projects with significant pumping energy, the EERs are corrected, if necessary, to represent the refrigeration cycle only, without any allowance for auxiliaries.[[272]](#footnote-272)

PECO also comments that the existing CF value of 80% is based on an average CF for multiple other jurisdictions, which is very high compared with CFs found in the C&I Unitary HVAC Loadshape study completed by NEEP.[[273]](#footnote-273) PECO notes that the CFs in the report range from 44% to 63% for the Mid-Atlantic PJM hours. PECO asserts that the existing deemed value of the CF could substantially overstate the coincident demand savings for HVAC measures. PECO further comments that the current source is not appropriate for Pennsylvania as peak demand periods vary by jurisdiction. PECO recommends developing a proper load shape for HVAC systems in Pennsylvania and calculating the CF based on the new peak demand period.[[274]](#footnote-274)

* + - 1. **Disposition**

The Commission rejects PECO’s recommendation to revise the definitions of EER to make reference to the working temperature of the fluid in cases where an existing system is being replaced. The Commission notes that, if the new water source heat pump system is an early replacement or replace on burnout scenario, it should have little effect on the new versus the old operating temperature of the system unless the pumps are changed out for smaller or larger ones. Assuming the same source temperature and load requirements, the Commission believes that the operating temperature would always remain the same, regardless of the early replacement or replace on burnout scenario. The Commission recommends that PECO provide supporting studies or data before this can be considered, especially since this would require introducing an operating temperature dependency to the savings calculation, which would bring additional complexity. If such information is available, the Commission directs the PEG to review such data and provide recommendations for future TRM updates.

The Commission rejects PECO’s recommendation to allow the EDCs to correct the EERs, if necessary, to represent the refrigeration cycle only, without any allowance for auxiliaries. The Commission believes that this is already addressed by the pump power being explicitly calculated and, therefore, separated from the refrigeration cycle energy consumption/power draw. However, the Commission has provided clarification, in the EER definitions regarding the cooling EER of the baseline unit, per PECO’s request.

The Commission agrees with PECO that the existing average CF from multiple other jurisdictions is likely not the best proxy to use in lieu of actual Pennsylvania data. The Commission recognizes the need to update the CF assumptions to reflect the new peak demand period in Pennsylvania.

The Commission further agrees with PECO that the existing CF value of 80% is very high compared with CFs found in the NEEP C&I Unitary HVAC Loadshape Study completed in June of 2011, which could substantially overstate the coincident demand savings for HVAC measures. The Commission has updated the CF value to 55% for all unitary HVAC systems included in Section 3.6 of the TRM.

The Commission agrees with PECO’s recommendation to update the summer demand savings deemed values to represent the new peak demand period. The Commission further agrees with PECO that hourly load profiles should be developed to determine the CF. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates. If load shapes are not already available for any of the measures, the Commission directs the PEG to provide recommendations for future TRM updates.

* 1. **Ductless Mini-Split Heat Pumps – Commercial < 5.4 tons**

The ductless mini split heat pump protocol documents the energy savings attributed to ENERGY STAR ductless mini-split heat pumps. In the 2013 TRM Order, the Commission directed the PEG to review this measure and determine if updates were necessary.[[275]](#footnote-275) While the SWE and the PEG have done some research on this topic, the Commission believes that further review is required to determine how to revise the load factor assumption to accurately represent savings. Therefore, the Commission proposed that this topic be referred to the PEG for review and that recommendations be provided for future TRM updates.

* + - 1. **Comments**

PECO notes that some of the existing systems mentioned as baseline systems could easily co-exist with the installation of a DHP system. In order to ensure the full savings are realized, PECO recommends that the old systems be de-energized, completely uninstalled and removed. PECO also notes that the CF has not been updated to account for the new peak demand period. PECO further states that the source note for the CF does not clarify on what peak period the CF is based. PECO recommends developing a load shape for commercial DHPs for Pennsylvania cities and updating CF using the new peak period.[[276]](#footnote-276)

PennFuture/KEEA comments that the measure characterization provides data for several baseline systems and notes that, for several situations, the assumed baseline for cooling is a standard central AC SEER. PennFuture/KEEA raises a concern that, when a DHP is installed in such a space, the measure characterization will generate cooling energy savings (assuming the DHP SEER rating exceeds the standard) even though there will be an actual energy increase. PennFuture/KEEA notes that the measure characterization does not provide any guidance on whether, or, how to account for this possibility on a case-by-case basis or as an average effect across all installations. PennFuture/KEEA recommends considering a similar approach for the C&I protocol in order to address the possibility of increased consumption resulting from DHP installation. PennFuture/KEEA further recommends that evaluation efforts attempt to understand customer motivation and likely baseline behavior to more accurately characterize the savings.[[277]](#footnote-277)

* + - 1. **Disposition**

The Commission acknowledges PECO’s comments that some of the existing systems mentioned as baseline systems could easily co-exist with the installation of a DHP system. The Commission agrees with PECO’s recommendation that the old systems should be de-energized, completely uninstalled and removed in order to ensure the full savings are realized. In addition, the Commission believes that, in order to use a baseline other than the standard baselines in Table 3-68, the old system must be removed.

The Commission agrees with PECO’s recommendation to update the summer demand savings deemed values to represent the new peak demand period. The Commission further agrees with PECO that hourly load profiles should be developed to determine the CF. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates.

In response to PennFuture/KEEA’s concern about overestimating savings from the installation of DHP in existing spaces without prior cooling or heating systems in place, the Commission clarifies that the measure is intended to encourage customers to install a more efficient DHP system instead of installing standard equipment that meets minimal code requirements. The Commission believes that this scenario arises when the customer has already decided to install a cooling or heating system even if there is a system currently in place. The Commission notes that other changes proposed by PennFuture/KEEA cannot be made without more review and consideration. The Commission, therefore, invites PennFuture/KEEA (and other interested stakeholders) to provide greater clarity regarding its proposals during future TRM updates.

* 1. **ENERGY STAR Electric Steam Cooker**

The Tentative Order did not discuss the CF assumptions for ENERGY STAR Electric Steam Cooker measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO noted that the CF has not been updated to account for the new peak demand period. PECO further states that the source note for the CF does not clarify on what peak period the CF is based. PECO recommends developing a load shape for commercial food service equipment for Pennsylvania cities and updating CF using the new peak period.[[278]](#footnote-278)

* + - 1. **Disposition**

The Commission agrees with PECO’s recommendation to update the summer demand savings deemed values to represent the new peak demand period. The Commission further agrees with PECO that hourly load profiles should be developed to determine the CF. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates.

The Commission also clarifies that the existing CF value is assumed to be similar to that of general C&I lighting equipment and was adopted from the RLW Analytics 2007 Study.[[279]](#footnote-279)

* 1. **Office Equipment – Network Power Management Enabling – Deemed Savings Values**

The 2013 TRM deemed savings for the office equipment network power management system measure were 135 kWh per unit and 0.0078 kW per unit. The energy savings were based on an evaluation study conducted in the Pacific Northwest[[280]](#footnote-280) with an expiration date of July 1, 2013. The Commission directed the PEG to monitor technological changes and provide recommendations for future TRM updates.[[281]](#footnote-281)

The SWE and the Commission found that the Pacific Northwest study is the most recent and comprehensive study available. As such, the Commission proposed to continue using the existing deemed savings values until better information is available. The Commission proposed that the PEG continue to monitor this issue and provide recommendations for consideration during future TRM updates.

**a. Comments**

PennFuture/KEEA comments that many of the controller workstations are likely to include ENERGY STAR components and raises the possibility of double-counting savings from this measure.[[282]](#footnote-282)

**b. Disposition**

The Commission acknowledges PennFuture/KEEA’s comments but notes that the deemed savings in the TRM already account for PennFuture/KEEA’s concerns. Specifically, the Commission notes that the baseline desktop usage is derived as a weighted mix of ENERGY STAR compliant and non-compliant models, and a mix of desktop categories. Baseline duty cycle is drawn from empirical studies, taking into account the enabled built-in power management of computers and monitors before applying the effects of a centralized power management control. The savings come from an increase in the rate of time spent in the "Off" state due to the ability of the network application to shut the computer down when not in prolonged use. The shift in hours from idle state to off state is based on empirical studies of power management installations.

* 1. **Refrigeration – Door Gaskets for Walk-in and Reach-in Coolers and Freezers – Deemed Savings Values**

The refrigeration – door gaskets protocol documents the energy and peak demand savings attributed to installation of door gaskets in walk-in coolers and freezers. The deemed savings values for each Pennsylvania reference city were taken from the associated California climate zones listed in the California work paper[[283]](#footnote-283) to account for differences in climate. There are sixteen California climate zones. Each of the seven reference cities are mapped to a California climate zone as shown in Table1-2 based on comparable number of cooling degree days and average dry bulb temperatures. The Commission proposed to update deemed savings values based on revised weather mapping methodology. In addition, reference to the weather mapping table were clearly mentioned in this protocol to provide clarity. The Commission further proposed that, due to the relatively small contribution of savings toward the EDCs’ portfolios as a whole and due to the lack of Pennsylvania-specific data, the *ex-ante* savings based on the analysis completed in California will be used until Pennsylvania-specific research is conducted.

**a. Comments**

PECO states that indoor conditions are the major driving factor of savings for this measure and are unlikely to differ greatly from the measured savings in the EM&V Report that is referenced in this measure protocol. PECO further notes that the Southern California Edison study[[284]](#footnote-284) results are more conservative, but, in some cases, are more than ten times the measured *ex-post* savings. PECO recommends using the evaluated *ex-post* savings for this measure rather than the *ex-ante* savings provided in the EM&V Report.[[285]](#footnote-285)

**b. Disposition**

The Commission accepts PECO’s recommendation to update the deemed savings values for this measure using the evaluated *ex-post* savings rather than the SCE *ex-ante* savings provided in the EM&V Report. As such, the Commission has removed Tables 3-78 to 3-83 from the TRM and added a new table with the evaluated savings from the California study. The Commission notes that it is not aware of the availability of supporting data and calculations to develop estimates for peak demand savings for Pennsylvania. If such data has been, or can be, developed, the Commission directs the PEG to review such data and provide recommendations for future TRM updates.

* 1. **Electric Resistance Water Heaters and Heat Pump Water Heaters**

The Tentative Order did not discuss these measure protocols. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO recommends expanding these measures to include larger commercial units in food service building types, which often use large quantities of hot water. PECO also recommends updating the Energy to Demand Factor and the language, where appropriate and the new peak period. With regard to hot water temperatures, PECO suggests updating the temperature of hot water (T hot) assumption to 123 °F to be consistent with the residential water heater measures. PECO recommends renaming several tables and sections related to these measures. Lastly, PECO suggests removing the deemed savings values and inserting a deemed savings algorithm for ΔkWh similar to the residential water heater measure protocols. PECO states that this would reflect the revision of this measure to a default value for EF base and EF proposed rather than a deemed value, and also reflects allows the default savings to be based on tank size.[[286]](#footnote-286)

* + - 1. **Disposition**

The Commission adopts all of PECO’s proposed changes with one exception. The Commission agrees with PECO’s recommendation to expand the measure to include larger commercial units in food service building types such as restaurants. However, we believe this task requires further review and direct the PEG to research this topic and provide recommendations for future TRM updates.

* 1. **LED Channel Signage**

In the 2013 TRM Final Order, the Commission directed the PEG to determine the appropriateness of splitting the savings for the LED channel signage measure into two categories based on sizing.[[287]](#footnote-287) The Commission proposed to modify the LED channel signage protocol by splitting the deemed savings into channel signs greater than two feet tall and those two feet or less. The Commission also proposed to add separate algorithms to calculate energy and peak demand savings for indoor and outdoor applications.

* + - 1. **Comments**

PECO recommends removing language from Section 3.30.1 as the language adds no value to the eligibility requirements and may inappropriately limit the protocol to only red or white tubes, even though there are a multitude of gas filled tubes. PECO states that the existing algorithms do not provide an option to account for reduced hours due to baseline controls. PECO recommends modifying the algorithms, as well as adding corresponding definitions for SVG base and SVG EE. PECO also suggests replacing the variable “EFLH” with “HOU” in Table 3-101 to be consistent with the algorithms. PECO recommend adding variables for SVGbase and SVGEE. FirstEnergy recommends making CF also an open variable as it may be nonzero in some outdoor applications.[[288]](#footnote-288)

* + - 1. **Disposition**

The Commission agrees with the recommendations provided by PECO and FirstEnergy and has updated the TRM accordingly.

* 1. **Low Flow Pre-Rinse Sprayers for Retrofit Programs**

During the 2013 TRM update, the Commission directed the PEG to review the market baseline adjustment factor assumption for the Low Flow Pre-Rinse Sprayers for Retrofit Programs and provide recommendations for future TRM updates.[[289]](#footnote-289) The SWE reviewed the market baseline adjustment factor assumption to check the reasonableness of the value and to determine if any updates were needed based on the latest information available and found that there are no additional models added to the Food Service Technology Center Website or the manufacturer on-line product catalogs used as sources in the 2013 TRM. The Commission believes that the sources used in the 2013 TRM are the most reliable and that no updates to the protocol are necessary at this time.

* + - 1. **Comments**

PECO recommends updating the Energy to Demand Factor and the language where appropriate using the provided water heater load profile in Figure 3-7 and the new peak period. PECO also suggests renaming Section 3.31.3 to “Default Savings” as the measure has been adjusted to a partially deemed algorithm.[[290]](#footnote-290)

* + - 1. **Disposition**

The Commission agrees with PECO’s recommendations.

* 1. **Low Flow Pre-Rinse Sprayers for Time of Sale / Retail Programs**

The Tentative Order did not discuss the Low Flow Pre-Rinse Sprayers for Time of Sale / Retail Programs measure protocol. However, comments were provided and are addressed below.

* + - 1. **Comments**

PECO recommends updating the Energy to Demand Factor and the language where appropriate using the provided water heater load profile in Figure 3-9 and the new peak period. PECO also suggests renaming Section 3.32.3 to “Default Savings” as the measure has been adjusted to a partially deemed algorithm. In addition, PECO suggests replacing the word “deemed” with “default” in Section 3.32.3 and title for Table 3-105.[[291]](#footnote-291)

* + - 1. **Disposition**

The Commission agrees with PECO’s recommendations.

* 1. **Small C/I HVAC Refrigerant Charge Correction**

The Tentative Order did not discuss the Small C/I HVAC Refrigerant Charge Correction measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO notes that the CF has not been updated to account for the new peak demand period. PECO further states that the source note for the CF does not clarify on what peak period the CF is based. PECO recommends developing a load shape for commercial small HVAC units for Pennsylvania cities and updating CF using the new peak period.[[292]](#footnote-292)

* + - 1. **Disposition**

The Commission clarifies that the existing CF is estimated by taking an average of CF values from multiple other jurisdictions which is likely not the best proxy to use in lieu of actual Pennsylvania data. The CF value references the same source used for Section 3.6 (HVAC Systems). The Commission recognizes the need to update the CF assumptions to reflect the new peak demand period in Pennsylvania. The Commission also updated the CF value to 55% to reflect the changes made to Section 3.6 based on the feedback received from PECO.

The Commission further agrees with PECO that hourly load profiles should be developed to determine the CF. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates.

* 1. **ENERGY STAR Room Air Conditioners**

The Tentative Order did not discuss the baselines and CF assumptions for the ENERGY STAR Room Air Conditioner measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO notes that the CF has not been updated to account for the new peak demand period. PECO further states that the source note for the CF does not clarify on what peak period the CF is based. PECO recommends developing a load shape for commercial room air conditioners for Pennsylvania cities and updating CF using the new peak period.[[293]](#footnote-293)

PennFuture/KEEA states that the measure characterization does not reflect the new federal standard for room air conditioners that will take effect June 1, 2014, resulting in overstated savings. PennFuture/KEEA recommends revising the characterization to incorporate the new federal standard that will become effective June of 2014 and also to distinguish between new units and early replacement units.[[294]](#footnote-294)

* + - 1. **Disposition**

The Commission clarifies that the existing CF is estimated by taking an average of CF values from multiple other jurisdictions which is likely not the best proxy to use in lieu of actual Pennsylvania data. The CF value references the same source used for Section 3.6 (HVAC Systems). The Commission recognizes the need to update the CF assumptions to reflect the new peak demand period in Pennsylvania. The Commission also updated the CF value to 55% to reflect the changes made to Section 3.6 based on the feedback received from PECO.

The Commission further agrees with PECO that hourly load profiles should be developed to determine the CF. As discussed previously, the Commission directs the PEG to obtain load shapes for all existing measures in the TRM and provide recommendations for future TRM updates.

The Commission agrees with PennFuture/KEEA’s recommendations.

* 1. **Variable Speed Refrigeration Compressor**

The Tentative Order did not discuss the Variable Speed Refrigeration Compressor measure protocol. However, comments were received and are addressed below.

* + - 1. **Comments**

PECO states that variable speed refrigeration compressor measure protocol should not apply to reciprocating compressors. PECO notes that these types of compressor do not run inefficiently at partial load and, therefore, do not benefit from VFDs. PECO suggests that grocery stores be ineligible for this measure. In addition, PECO asserts that this measure should apply only to screw compressors.[[295]](#footnote-295)

* + - 1. **Disposition**

The Commission rejects PECO’s recommendation that the variable speed refrigeration compressor measure protocol should not apply to reciprocating compressors. We understand that reciprocating compressors unload more efficiently than screw compressors, especially with less than 50% part load. However, the Commission believes that adding a VFD to a reciprocating compressor in lieu of slide valve, or especially on/off or hot gas bypass control, still enables the system to gain the bulk of the energy savings from the upgrade to a VFD.

The Commission also rejects PECO’s recommendation that grocery stores should be excluded from this measure. Although, the SWE and the Commission agree that grocery stores typically use multiplex systems, generally speaking, compressor control schemes vary – so assuming a certain compressor does not run at full load is not prudent. The Commission can think of two examples where one compressor may be running at full load: 1) to balance run time of each compressor in the rack (lead-lag) or 2) if the compressors are of different capacities (ASHRAE Handbook Section R15.14). The Commission, therefore, believes that grocery stores should continue to be included in this measure as they may still generally benefit from significant energy savings, but just may not realize those savings as much as other facilities heavy on refrigeration due to the reasons PECO noted.

The Commission also rejects PECO’s recommendation that this measure should apply only to screw compressors that are common in industrial or agricultural applications. The Commission believes that both reciprocating and screw types are positive displacement technologies and can be used in the same applications.

1. **Appendix C (Lighting Inventory Tool)**

In its Tentative Order, the Commission proposed to update Appendix C - Lighting Inventory Tool to reflect all the improvements made to the C&I lighting protocols in the 2014 TRM. In addition, the Commission proposed to expand the wattage table based on the feedback received from the PEG.

**1. Comments**

PECO requests that the Commission ensure that the definitions in the TRM are correct and ensure consistency between the TRM and Appendix C. PECO recommends including initial lumens in the wattage table for all fixtures. PECO suggests changing cell A1 on the Controls Form tab to say “Lighting Controls Form” to distinguish it from the lighting form. PECO recommends labeling the lighting CFs on the Controls Form tab as base lighting usage CFs, to distinguish them from controls measure CFs. PECO suggests changing cell D8 to “Control Usage Group” on the Controls Form tab. PECO suggests saying “number of fixtures controlled by the measure” instead of “number of fixtures” in the Control section. Lastly, additional lamp/fixture wattages are requested to cover Commercial MultiFamily (common area) measures, including: High Performance T8s, Reduced Wattage High Performance T8s, and Exterior High Wattage Pin Based CFL Fixtures.[[296]](#footnote-296)

PennFuture/KEEA states that Appendix C includes some technologies that may be considered baseline themselves. PennFuture/KEEA notes that the Prescriptive Lighting Table included with the lighting tool provides savings values for retrofitting existing T-12 fixtures with standard efficiency T-8s. PennFuture/KEEA asserts that this is a sub-optimal technology selection, because high-performance T-8 technology provides additional savings for very little additional cost. PennFuture/KEEA recommends that the Commission ensure that the savings algorithms and the Lighting Inventory Tool do not result in the promotion of measures that are sub-optimal.[[297]](#footnote-297)

1. **Disposition**

The Commission clarifies that the Appendix C controls savings formulas do follow the algorithms in the TRM. The Commission has made the changes requested by PECO, noting one exception. The Commission agrees with PECO’s request to expand the wattage table by adding additional lamp/fixture wattages to cover Commercial MultiFamily (common area) measures, including: High Performance T8s, Reduced Wattage High Performance T8s, and Exterior High Wattage Pin Based CFL Fixtures. The Commission, however, believes that it has insufficient information to make such changes, at this time. As such, the Commission directs the PEG to review this suggestion and provide recommendations during future TRM updates.

The Commission also updated the “Fixture Code Locator” to make it compatible with Pulse-Start Metal Halide entries, which was originally broken. We also revised the “Manual” tab to reflect all changes to the TRM and Appendix C.

The Commission acknowledges PennFuture/KEEA’s comments that Appendix C contains some lighting technologies that are no longer offered. However, due to the phasing in of the EISA standards, the Commission will retain those technologies in Appendix C, at this time. The Commission directs the PEG to review those technologies and their appropriateness for inclusion in Appendix C during future TRM updates.

1. **Appendix D (Motors and VFD Savings Calculator)**

In its Tentative Order, the Commission proposed to update Appendix D - Motors and VFD Savings Calculator to reflect all the improvements made to the C&I Motors and VFD protocols in the 2014 TRM.

* 1. **Comments**

FirstEnergy states that, to avoid overestimating operating hours where motors or VFDs are operated in duplex configuration in Appendix D, both the motor form and VFD form need to include a 0.5 factor in the EFLH for those configurations. FirstEnergy notes that the CF has this factor built in, but not the hours. FirstEnergy also suggests modifying the calculator to allow custom HP values.[[298]](#footnote-298)

* 1. **Disposition**

The Commission rejects FirstEnergy’s recommendation to include a 0.5 factor in the EFLH value for VFDs operating in duplex configuration. The Commission clarifies that the way “Duplex” is currently defined, no EFLH factor is required.  Duplex is defined as if the motors are redundant and only one is operating at any given time. The Commission accepts FirstEnergy’s suggestion to modify Appendix D to allow EDCs to input custom HP values, where appropriate.

In addition to accepting recommendations above and making revisions, the Commission also made the following revisions to reflect values in Section 3.3 and Section 3.4. In the Motors Form, the Commission updated the baseline efficiency tables. We removed the EPACT baseline motors table, which is no longer applicable to Phase II of Act 129 Programs. The Commission added separate tables for NEMA premium Subtype I and Subtype II efficiency tables and incorporated these in the calculations, as well as added a column “Additional Configuration Details” where the customer can pick any of the specialty motors that would classify the motor as Subtype II instead of Subtype I. In the VFD Form, we fixed the Program Year drop down (cell K6) and removed all of the efficiency lookup tables from the VFD form since these are no longer needed. The motor HP and efficiencies are manually entered by the user. Lastly, we updated the Manual and Glossary tabs to reflect all changes to the TRM and Appendix D.

1. **Appendix E (New Construction Calculator)**

The Tentative Order did not discuss the Appendix E (New Construction Calculator). However, comments were received and are addressed below.

* 1. **Comments**

PECO recommends renaming Appendix E to “Appendix E: Lighting Audit and Design Tool for Commercial and Industrial New Construction Projects.” Regarding Tab 01, Interior Lighting Form, PECO suggests applying a load reduction factor to both allowed and installed watts to account for dimming requirements in code. In Tab 03, Exterior Lighting Form, PECO recommends correcting the cell references to include the first row of user input cells, as well as eliminating the rounding function in the interior lighting form. Regarding Tab 08 Fixture Code Locator, cells B18 and B29 have an external link to an Appendix C file.[[299]](#footnote-299)

FirstEnergy states that the tool would be more convenient to use if the fixture codes in column F were available with a drop-down menu like in Appendix C, and if the Facility Type in cell C96 could be selected with a drop-down menu. FirstEnergy believes that the interactive effects should be calculated on a space-by-space basis rather than on a whole-facility basis.[[300]](#footnote-300)

* 1. **Disposition**

The Commission has accepted the recommendations from PECO and FirstEnergy, with one exception, and has updated Appendix E accordingly. The Commission acknowledges PECO’s comment about the need for a load reduction factor to both allowed and installed watts to account for dimming requirements in code. However, the Commission does not have enough information, at this time, to make such changes. As such, we direct the PEG to review this suggestion and provide recommendations during future TRM updates.

## J. Application of the TRM

While the Commission did not discuss the annual updating process of the TRM in detail in its Tentative Order, comments were provided regarding this process and are addressed below.

**1. Comments**

EAP expresses concern that the Commission’s efforts at finding the perfect way to measure savings through a process which requires an annual shift in implementation and new ways to calculate savings does not balance the desire for mathematical accuracy with considerations of cost-effectiveness and consumer confusion. EAP, FirstEnergy and PPL suggest timing the application of future TRM revisions to coincide with the beginning of EE&C phases, rather than annually. EAP believes that the annual updating of the TRM does little to advance consumer support and participation in the EE&C programs and may, in fact, strengthen consumer ambivalence in a market where energy prices are relatively stable and low. Additionally, EAP, PECO and PPL contend that the annual updating process increases the cost of EM&V and increases the risk that the EDCs will not meet the reduction targets established by the Commission.[[301]](#footnote-301)

PennFuture/KEEA thanks the Commission for undertaking an annual updating process for the TRM as the information gained from program implementation each year will inform more accurate savings estimates. PennFuture/KEEA also states that measure baselines, high efficiency measure definitions and measure savings are rarely static, even over short periods of time, and, as such, the EDCs should anticipate such changes and have sufficient flexibility in their program planning and implementation activities to respond to these changes.[[302]](#footnote-302)

**2. Disposition**

Through the entirety of the EE&C Program, the Commission maintained its position that the TRM should be updated annually to reflect not only new protocols, but changes related to federal and state standards, code changes and technological upgrades. As such, our position has always been that the annual TRM update may include revisions to existing protocols to establish a more accurate reflection of savings values.

As we stated in our prior TRM update orders, “the TRM is merely guidance or a statement of policy that is not binding regulation.”[[303]](#footnote-303) We continued by stating that

a final determination of an EDC’s EE&C Plan’s energy savings will be determined in an adjudicatory proceeding where the EDC will be afforded the opportunity to present evidence demonstrating what energy savings its plan obtained and the credibility of that evidence. An EDC is free to use any method to determine the energy savings produced by its plan, in place of the TRM, provided it can support such determinations with substantial credible evidence, if necessary. Furthermore, by updating the TRM methods and values based on the most recent credible and accurate data and facts, as they become known, is likely to reduce challenges to the credibility of the energy savings attributable to the EDCs’ Plans in any future proceeding.[[304]](#footnote-304)

We stress again that while the TRM is a tool EDCs can use to estimate the amount of energy savings a program offering can potentially provide to its plan as a whole, the TRM is first and foremost a measurement tool used to determine, in a reasonably cost-effective way, the actual energy savings achieved by specific measures after they have been installed or implemented.

The Commission believes it has adequately explained its reasoning in performing annual updates to the TRM in a variety of proceedings, including past TRM updates.[[305]](#footnote-305) Specifically, in the Phase II Implementation Order, we stated the following:

In maintaining up-to-date information, the Commission assures that Act 129 monies collected from ratepayers are reflecting the truest savings possible. Additionally, while we recognize the concerns expressed by the EDCs regarding compliance, the Commission has not been provided with any arguments as to why updating the TRM any less frequently than annually is beneficial to ratepayers. To be more specific, the EDCs’ comments focus on the effects the annual TRM updating procedure has on their ability to attain their targets and in no way address the accuracy of the deemed savings values. We believe the focus should be on providing the most accurate measure of reductions in energy consumption possible and to ensure that Act 129 monies are being spent to acquire real energy savings, not fictitious savings values that only serve to protect the EDCs from potential penalties.[[306]](#footnote-306)

The Commission maintains this position in this proceeding.

# CONCLUSION

This Order represents the Commission’s continuing efforts in establishing a comprehensive TRM with a purpose of supporting both the AEPS Act and the EE&C Program provisions of Act 129. The Commission is referring several of the comments we received to the PEG and SWE to consider and provide recommendations for future TRM updates. As such, Commission staff will provide an update on the final disposition of all such comments in the next TRM update order. We extend our thanks to all who provided comments; **THEREFORE,**

**IT IS ORDERED:**

1. That the 2014 Technical Reference Manual update, as modified by this Order, is adopted and replaces all prior versions of the Technical Reference Manual as of June 1, 2014.

2. That a copy of this Order shall be served upon the Office of Consumer Advocate, the Office of Small Business Advocate, the Commission’s Bureau of Investigation and Enforcement, the Pennsylvania Department of Environmental Protection and all parties who filed comments.

3. That the Secretary shall deposit a notice of this Order and 2014 version of the Technical Reference Manual with the Legislative Reference Bureau for publication in the *Pennsylvania Bulletin*.

4. That this Order and the 2014 Technical Reference Manual update, as well its appendices by published on the Commission’s website at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/technical_reference_manual.aspx>.



**BY THE COMMISSION**

Rosemary Chiavetta

Secretary

(SEAL)

ORDER ADOPTED: December 19, 2013

ORDER ENTERED: December 19, 2013

1. Order entered on October 3, 2005, at Docket No. M-00051865 (October 3, 2005 Order). [↑](#footnote-ref-1)
2. *See* October 3, 2005 Order at 13. [↑](#footnote-ref-2)
3. *See Energy Efficiency and Conservation Program* Implementation Order at Docket No. M‑2008‑2069887, (Phase I Implementation Order), at page 13, entered January 16, 2009. [↑](#footnote-ref-3)
4. *Id*. [↑](#footnote-ref-4)
5. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual* Update Order at Docket No. M‑00051865, (2009 TRM), entered June 1, 2009. [↑](#footnote-ref-5)
6. *Id*. at 17 and 18. [↑](#footnote-ref-6)
7. *See Energy Efficiency and Conservation Program* Implementation Order, at Docket No. M‑2012‑2289411, (Phase II Implementation Order), entered August 3, 2012, at 71. [↑](#footnote-ref-7)
8. *Id*. at 75. [↑](#footnote-ref-8)
9. The PEG is chaired by staff of the Commission’s Bureau of Technical Utility Services and is comprised of representatives from the EDCs and the SWE for the purpose of encouraging discussion of EDC program-specific issues and associated evaluation, measurement and verification. [↑](#footnote-ref-9)
10. The TWG is chaired by staff of the Commission’s Bureau of Technical Utility Services and is comprised of representatives from the EDCs, the SWE and other interested parties for the purpose of encouraging discussion of the technical issues related to the evaluation, measurement and verification of savings programs to be implemented pursuant to Act 129. [↑](#footnote-ref-10)
11. The Commission held a TWG meeting on July 15, 2013, to provide stakeholders with the opportunity to review proposed high impact changes to residential, commercial and industrial measures, and also allow for a question and answer session regarding those changes. Additionally, stakeholders had the opportunity to propose any other changes they would like to have made to the TRM. [↑](#footnote-ref-11)
12. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual Update*, Final Order at Docket No. M-00051865, (2010 TRM), entered June 8, 2010. *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual Update*, Final Order at Docket No. M-00051865, (2011 TRM), entered February 28, 2011. *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2012 Update*, Final Order at Docket No. M‑00051865, (2012 TRM), entered December 16, 2011. And *Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2013 Update*, Final Order at Docket No. M-2012-2313373, (2013 TRM), entered December 20, 2012. [↑](#footnote-ref-12)
13. *See Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources – Technical Reference Manual 2014 Update*, Tentative Order, entered on August 29, 2013, at Docket No. M-2012-2313373 (Tentative Order). [↑](#footnote-ref-13)
14. <http://www.pabulletin.com/secure/data/vol43/43-37/index.html> [↑](#footnote-ref-14)
15. Tentative Order at 17. [↑](#footnote-ref-15)
16. PECO Comments at 2. [↑](#footnote-ref-16)
17. *See* Section 1.1, page 1, of the 2013 TRM. [↑](#footnote-ref-17)
18. *See Evaluation Framework for Pennsylvania Act 129 Phase II Energy Efficiency and Conservation Programs*, prepared by GDS Associates, Inc., *et al.*, June 30, 2013. (Phase II Evaluation Framework) Available at <http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseII-Evaluation_Framework063013.pdf>. [↑](#footnote-ref-18)
19. Duquesne Comments at 3. [↑](#footnote-ref-19)
20. *See* *2012 PA Total Resource Cost Test* Order, at Docket Nos. M-2012-2300653 and M-2009-2108601, (2013 TRC Test Final Order), entered August 30, 2012. [↑](#footnote-ref-20)
21. *See* Tentative 2014 TRM section 1.12.2 [↑](#footnote-ref-21)
22. Duquesne Comments at 5. [↑](#footnote-ref-22)
23. PennFuture/KEEA Comments at 4 and 8. [↑](#footnote-ref-23)
24. *See* Phase II Implementation Order at 26. [↑](#footnote-ref-24)
25. PECO Comments at 6. [↑](#footnote-ref-25)
26. PennFuture/KEEA Comments at 11. [↑](#footnote-ref-26)
27. PennFuture/KEEA Reply Comments at 3. [↑](#footnote-ref-27)
28. A stipulated value for a stipulated variable refers to a single input value to an algorithm, while a deemed savings estimate is the result of calculating the end result of all of the stipulated values in the savings algorithm. [↑](#footnote-ref-28)
29. Open variables are listed with a default value and an option for EDC data gathering. [↑](#footnote-ref-29)
30. Duquesne Comments at 3 and 4. [↑](#footnote-ref-30)
31. The thresholds kWh/year will be stipulated in the 2014 TRM and will vary depending on the type of end-use category. [↑](#footnote-ref-31)
32. For example, linear fluorescent lighting, CFL lighting, and LED lighting are individual measures within the Lighting end-use category. [↑](#footnote-ref-32)
33. In situations where a CSP meters a project because the expected kWh savings are above the established threshold and then realizes that the actual savings are below the threshold, metered results should be used for reporting claimed and verified savings. [↑](#footnote-ref-33)
34. PECO Comments at 6 and 9. [↑](#footnote-ref-34)
35. PPL Comments at 5, FirstEnergy Comments at 5 and 12, and EAP Comments at 5. [↑](#footnote-ref-35)
36. The existing threshold for logging HOU is a lighting project with a change in connected load greater than 200 kW. [↑](#footnote-ref-36)
37. PPL Comments at 5 and 6. [↑](#footnote-ref-37)
38. FirstEnergy Comments at 5. [↑](#footnote-ref-38)
39. Duquesne Comments at 6 and 7. [↑](#footnote-ref-39)
40. PennFuture/KEEA Reply Comments at 3. [↑](#footnote-ref-40)
41. PPL Comments at 5 and 6. [↑](#footnote-ref-41)
42. FirstEnergy Comments at 6, 12 and 13. [↑](#footnote-ref-42)
43. The overall budget for the Phase II Commercial Lighting Metering Study is $760,422 for a sample size of 500 sites. The average cost per site is $1,521. Participant recruitment and the on-site assessments represent the majority of the estimated cost. Lighting study planning and data analysis and reporting represent the remaining cost. The labor costs associated with the lighting study effort include sample selection, recruitment, scheduling, completing the on-site visits (install and removal), drive time, data clean-up, analysis, and reporting. The non-labor costs include an estimated $75 incentive per site visit; all travel costs, per diem, equipment purchases, and other expenses. Although the Commission realizes that it is not an apples to apples comparison, we believe that the costs to conduct metering and analysis would be largely similar to the metering study budget assumptions. [↑](#footnote-ref-43)
44. EDC evaluation contractors must verify the project-specific M&V data (including pre and post metering results) obtained by the CSPs, as practicable, for projects in the evaluation sample. If the evaluation contractor determines that data collected by the CSPs are not reasonably valid, then the evaluator must perform measurements consistent with IPMVP options to collect post-retrofit information for projects that have estimated savings above a threshold kWh/year level. The SWE reserves the right to audit and review claimed and verified impacts of any project selected in the evaluation sample. [↑](#footnote-ref-44)
45. PECO Comments at 7 and 8. [↑](#footnote-ref-45)
46. PECO Comments at 8. [↑](#footnote-ref-46)
47. PPL Comments at 4 and 5. [↑](#footnote-ref-47)
48. PECO Comments at 7, 9 and 10 and PPL Comments at 4. [↑](#footnote-ref-48)
49. PPL Comments at 4. [↑](#footnote-ref-49)
50. Duquesne Comments at 4. [↑](#footnote-ref-50)
51. PennFuture/KEEA Comments at 2. [↑](#footnote-ref-51)
52. PECO Comments at 6. [↑](#footnote-ref-52)
53. <http://www.evo-world.org/index.php?option=com_content&task=view&id=272&Itemid=279>. [↑](#footnote-ref-53)
54. www1.eere.energy.gov/femp/pdfs/mv\_guidelines.pdf. [↑](#footnote-ref-54)
55. If the CMPs use a top 100 hours approach for calculating peak demand savings, the protocol must be revised to address the new peak demand window definition. [↑](#footnote-ref-55)
56. PPL Comments at 4. [↑](#footnote-ref-56)
57. PECO Comments at 9 and 11 and FirstEnergy Comments at 6 and 7. [↑](#footnote-ref-57)
58. PennFuture/KEEA Comments at 3-5. [↑](#footnote-ref-58)
59. *Id*. [↑](#footnote-ref-59)
60. FirstEnergy Reply Comments at 2 and 3, PECO Reply Comments at 1 and PPL Reply Comments at 3‑5. [↑](#footnote-ref-60)
61. PennFuture/KEEA Reply Comments at 5. [↑](#footnote-ref-61)
62. PennFuture/KEEA Comments at 5. [↑](#footnote-ref-62)
63. FirstEnergy Comments at 6. [↑](#footnote-ref-63)
64. <http://www.deeresources.com/>. [↑](#footnote-ref-64)
65. *See* 2013 TRM Final Order at 14. [↑](#footnote-ref-65)
66. PECO Comments at 11. [↑](#footnote-ref-66)
67. PennFuture/KEEA Comments at 5. [↑](#footnote-ref-67)
68. <http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/ASHP_Sav_Calc.xls> [↑](#footnote-ref-68)
69. PECO Comments at 72-74. [↑](#footnote-ref-69)
70. *Id.* [↑](#footnote-ref-70)
71. PennFuture/KEEA Comments at 14. [↑](#footnote-ref-71)
72. *See* Section 7.3.6, page 374, of the 2012 Illinois TRM. [↑](#footnote-ref-72)
73. PECO Comments at 28, 29 and 74. [↑](#footnote-ref-73)
74. PECO Comments at 75 and 76 [↑](#footnote-ref-74)
75. *Id*. [↑](#footnote-ref-75)
76. PECO Comments at 70. [↑](#footnote-ref-76)
77. PECO Comments at 71 and 72. [↑](#footnote-ref-77)
78. PECO Comments at 17, 76 and 77. [↑](#footnote-ref-78)
79. PECO Comments at 74 and 75. [↑](#footnote-ref-79)
80. PECO Comments at 73 and 74. [↑](#footnote-ref-80)
81. PECO Comments at 79 and PPL Comments at 17. [↑](#footnote-ref-81)
82. PECO Comments at 72 and 73. [↑](#footnote-ref-82)
83. *See* 2013 TRM Final Order at 23. [↑](#footnote-ref-83)
84. *See* Section 2.1.2, pages 15 and 16, Table 2-1, of the 2013 TRM. [↑](#footnote-ref-84)
85. PPL Comments at 7. [↑](#footnote-ref-85)
86. *See* 2013 TRM Final Order at 27. [↑](#footnote-ref-86)
87. *See* page 48 of the 2013 Mid-Atlantic TRM. [↑](#footnote-ref-87)
88. Illinois Statewide TRM, 2013, “Central Air Conditioning in Wisconsin,” Energy Center of Wisconsin, May 2008, (2013 Illinois Statewide TRM). [↑](#footnote-ref-88)
89. PECO Comments at 13. [↑](#footnote-ref-89)
90. *See* 2013 TRM Final Order at 26. [↑](#footnote-ref-90)
91. PECO Comments at 13. [↑](#footnote-ref-91)
92. *See* 2013 TRM Final Order at 27 and 28. [↑](#footnote-ref-92)
93. McQuay Application Guide 31-008, Geothermal Heat Pump Design Manual, 2002. [↑](#footnote-ref-93)
94. Residential Ground Source Heat Pumps with Integrated Domestic Hot Water Generation: Performance Results from Long-Term Monitoring”, U.S. Department of Energy, November 2012 and Desuperheater Study, New England Electric System, 1998 42 U.S.C.A 6295(i) (West Supp. 2011) and 10 C.F.R. 430.32 (x) (2011). [↑](#footnote-ref-94)
95. PennFuture/KEEA Comments at 8. [↑](#footnote-ref-95)
96. PECO Comments at 13 and PennFuture/KEEA Comments at 6. [↑](#footnote-ref-96)
97. PennFuture/KEEA Comments at 8. [↑](#footnote-ref-97)
98. PennFuture/KEEA Comments at 5 and 6. [↑](#footnote-ref-98)
99. *Id.* [↑](#footnote-ref-99)
100. PECO Comments at 37-39, 46 and 48. [↑](#footnote-ref-100)
101. Nexus Market Research, “Impact Evaluation of the Massachusetts, Rhode Island and Vermont 2003 Residential Lighting Programs”, Final Report, October 1, 2004. [↑](#footnote-ref-101)
102. PECO Comments at 41, 46 and 51. [↑](#footnote-ref-102)
103. <http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/50> [↑](#footnote-ref-103)
104. PennFuture/KEEA comments at 6 and 7. [↑](#footnote-ref-104)
105. PECO Comments at 39, 48 and 49;PPL Comments at 13-15. [↑](#footnote-ref-105)
106. PECO Comments at 38, 39, 41 and 48-50. [↑](#footnote-ref-106)
107. *See* 2013 TRM Final Order at 31. [↑](#footnote-ref-107)
108. EmPOWER Maryland 2012 Final Evaluation Report: Residential Lighting Program, Prepared by Navigant Consulting and the Cadmus Group, Inc., March 2013. [↑](#footnote-ref-108)
109. PECO Comments at 40 and 49. [↑](#footnote-ref-109)
110. FirstEnergy Comments at 9. [↑](#footnote-ref-110)
111. The Phase II Lighting Metering Study is outlined in the Commission’s Phase II SWE Contract available at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/act_129_statewide_evaluator_swe_.aspx>. [↑](#footnote-ref-111)
112. *See* 2013 TRM Final Order at 30. [↑](#footnote-ref-112)
113. PennFuture/KEEA Comments at 6 and 7. [↑](#footnote-ref-113)
114. FirstEnergy Reply Comments at 3. [↑](#footnote-ref-114)
115. PennFuture/KEEA Comments at 6 and 7. [↑](#footnote-ref-115)
116. PennFuture/ KEEA comments at 6 and 7; PECO comments at 46. [↑](#footnote-ref-116)
117. PECO Comments at 41-46, 48, 49 and 51-56. [↑](#footnote-ref-117)
118. PennFuture/KEEA Comments at 4 and 5. [↑](#footnote-ref-118)
119. PPL Comments at 13-15 and PECO Comments at 39 and 49. [↑](#footnote-ref-119)
120. PennFuture/KEEA Comments at 6 and 7. [↑](#footnote-ref-120)
121. *See* 2013 TRM Final Order at 33. [↑](#footnote-ref-121)
122. PECO Comments at 40, 41, 50 and 51. [↑](#footnote-ref-122)
123. FirstEnergy Comments at 9 and 10. [↑](#footnote-ref-123)
124. PennFuture/KEEA Comments at 6 and 7. [↑](#footnote-ref-124)
125. While FirstEnergy references the sentence preceding Table 2-73, the sentence actually precedes Table 2-76. [↑](#footnote-ref-125)
126. *See* 2013 TRM Final Order at 32. [↑](#footnote-ref-126)
127. Nexus Market Research, “Impact Evaluation of the Massachusetts, Rhode Island and Vermont 2003 Residential Lighting Programs”, Final Report, October 1, 2004. [↑](#footnote-ref-127)
128. PECO Comments at 39, 40, 49 and 50. [↑](#footnote-ref-128)
129. PPL Comments at 13 and 14. [↑](#footnote-ref-129)
130. The discount rate was weighted to the number of residential customers in each EDC to provide a statewide average rate. [↑](#footnote-ref-130)
131. *See Electric Energy Efficiency Potential for Pennsylvania – Final Report*, (Market Potential Study), prepared for the Pennsylvania Public Utility Commission, submitted by GDS Associates, *et al.*, May 10, 2012. [↑](#footnote-ref-131)
132. *See* 2013 TRM Final Order at 77. [↑](#footnote-ref-132)
133. 2013 Illinois Statewide TRM - An estimate based on review of Madison Gas and Electric, Exterior Wall Insulation, R-value for no insulation in walls, and NREL's Building Energy Simulation Test for Existing Homes (BESTEST-EX). [↑](#footnote-ref-133)
134. PennFuture/KEEA Comments at 9. [↑](#footnote-ref-134)
135. PECO Comments at 30. [↑](#footnote-ref-135)
136. PPL Comments at 12. [↑](#footnote-ref-136)
137. *See* 2013 TRM Final Order at 62. [↑](#footnote-ref-137)
138. PennFuture/KEEA Comments at 3. [↑](#footnote-ref-138)
139. FirstEnergy Comments at 6. [↑](#footnote-ref-139)
140. 2009 International Residential Code (IRC 2009 Section N1102.4.4). [↑](#footnote-ref-140)
141. 2009 International Residential Code (N1104.1). [↑](#footnote-ref-141)
142. GDS Memo received from Architectural Energy dated 11.21.13 – Rob Salcido. [↑](#footnote-ref-142)
143. PECO Comments at 25. [↑](#footnote-ref-143)
144. *See* TRM table 2-29: DHP – Values and References. [↑](#footnote-ref-144)
145. PECO Comments at 25 and 26. [↑](#footnote-ref-145)
146. PPL Comments at 10. [↑](#footnote-ref-146)
147. FirstEnergy Comments at 8 and 9. [↑](#footnote-ref-147)
148. PECO Comments at 26. [↑](#footnote-ref-148)
149. PennFuture/KEEA Comments at 10. [↑](#footnote-ref-149)
150. PennFuture/KEEA Comments at 10. [↑](#footnote-ref-150)
151. PECO Comments at 32 and 33. [↑](#footnote-ref-151)
152. The Phase II Baseline Studies are outlined in the SWE’s contract available at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/act_129_statewide_evaluator_swe_.aspx>. [↑](#footnote-ref-152)
153. *See* Section 2.23 – ENERGY STAR Televisions, page 143, of the 2013 TRM. [↑](#footnote-ref-153)
154. PennFuture/KEEA Comments at 7 and 8. [↑](#footnote-ref-154)
155. ENERGY STAR Market & Industry Scoping Report, 2011. [↑](#footnote-ref-155)
156. NAHB Study of Life Expectance of Home Components, 2007. [↑](#footnote-ref-156)
157. PennFuture/KEEA Comments at 9; PECO Comments at 14. [↑](#footnote-ref-157)
158. PECO Comments at 14 and15. [↑](#footnote-ref-158)
159. PECO Comments at 23 and 37. [↑](#footnote-ref-159)
160. PECO’s October 31, 2012 Comments at Docket No. M-2012-2313373 at 1. [↑](#footnote-ref-160)
161. PennFuture/KEEA Comments at 9. [↑](#footnote-ref-161)
162. PECO Comments at 11 and PPL Comments at 7. [↑](#footnote-ref-162)
163. PECO’s October 31, 2012 Comments at Docket No. M-2012-2313373 at 1. [↑](#footnote-ref-163)
164. PennFuture/KEEA Comments at 9. [↑](#footnote-ref-164)
165. PECO Comments at 17 and PPL Comments at 8. [↑](#footnote-ref-165)
166. PECO Comments at 26. [↑](#footnote-ref-166)
167. PennFuture/KEEA Comments at 9. [↑](#footnote-ref-167)
168. PECO Comments at 26. [↑](#footnote-ref-168)
169. PECO Comments at 24. [↑](#footnote-ref-169)
170. PPL Comments at 9 and 10. [↑](#footnote-ref-170)
171. PennFuture/KEEA Comments at 10 and PECO Comments at 56. [↑](#footnote-ref-171)
172. *See* footnote 2 of the Phase I Residential Baseline Study. [↑](#footnote-ref-172)
173. FirstEnergy Comments at 7 and PPL Comments at 9. [↑](#footnote-ref-173)
174. *See* The Showerhead and Faucet Aerator Metering Study for Michigan Evaluation Working Group, the Cadmus Group and Opinion Dynamics Evaluation Team, June 2013. [↑](#footnote-ref-174)
175. PECO Comments at 18-20. [↑](#footnote-ref-175)
176. Aquacraft, Inc., Water Engineering and Management. The end use of hot water in single family homes from flow trace analysis. 2001. <http://www.aquacraft.com/sites/default/files/pub/DeOreo-(2001)-Disaggregated-Hot-Water-Use-in-Single-Family-Homes-Using-Flow-Trace-Analysis.pdf>. [↑](#footnote-ref-176)
177. Shower temperature cited from SBW Consulting, Evaluation for the Bonneville Power Authority, 1994, <http://www.bpa.gov/energy/n/reports/evaluation/residential/faucet_aerator.cfm>. [↑](#footnote-ref-177)
178. *See* footnote 2 of the Phase I Residential Baseline Study. [↑](#footnote-ref-178)
179. PECO Comments at 20-22 [↑](#footnote-ref-179)
180. Aquacraft, Inc., Water Engineering and Management. The end use of hot water in single family homes from flow trace analysis. 2001. <http://www.aquacraft.com/sites/default/files/pub/DeOreo-(2001)-Disaggregated-Hot-Water-Use-in-Single-Family-Homes-Using-Flow-Trace-Analysis.pdf>. [↑](#footnote-ref-180)
181. PennFuture/KEEA Comments at 10 and PECO Comments at 56. [↑](#footnote-ref-181)
182. 2014 PA TRM, Section 2.29 [↑](#footnote-ref-182)
183. PECO Comments at 23. [↑](#footnote-ref-183)
184. PennFuture/KEEA at 9. [↑](#footnote-ref-184)
185. PECO Comments at 22 and 23. [↑](#footnote-ref-185)
186. *See* Table 2-91 – High Efficiency Pool and Motor – Two Speed Pump Calculations Assumptions, page 168, of the 2013 TRM. [↑](#footnote-ref-186)
187. PECO Comments at 56 and 57. [↑](#footnote-ref-187)
188. *Ibid*. [↑](#footnote-ref-188)
189. PennFuture/KEEA Comments at 10. [↑](#footnote-ref-189)
190. PECO Comments at 57. [↑](#footnote-ref-190)
191. *See* Table 2-1 - Residential Electric HVAC – References, page 15, of the 2013 TRM. [↑](#footnote-ref-191)
192. PennFuture/KEEA Comments at 9 and PECO Comments at 12. [↑](#footnote-ref-192)
193. *See* 2013 TRM Final Order at 69. [↑](#footnote-ref-193)
194. “Electricity Savings Opportunities for Home Electronics and Other Plug-In Devices in Minnesota Homes,” Energy Center of Wisconsin, May 2010. [↑](#footnote-ref-194)
195. “Smart Plug Strips,” ECOS, July 2009. [↑](#footnote-ref-195)
196. Efficiency Vermont coincidence factor for smart strip measure – in the absence of empirical evaluation data, this was based on the assumptions of the typical run pattern for televisions and computers in homes. [↑](#footnote-ref-196)
197. “Smart Strip Electrical Savings and Usability”, David Rogers, Power Smart Engineering, October 2008. [↑](#footnote-ref-197)
198. *See* Table 2-23 – Smart Strip Plug Outlet Calculation Assumptions, page 59, of the 2013 TRM. [↑](#footnote-ref-198)
199. *See* 2013 TRM Final Order at 66. [↑](#footnote-ref-199)
200. PennFuture/KEEA Comments at 9, FirstEnergy Comments at 7 and 8 and PECO Comments at 23. [↑](#footnote-ref-200)
201. PPL Comments at 12 and PECO comments at 30. [↑](#footnote-ref-201)
202. PECO Comments at 30 and 31. [↑](#footnote-ref-202)
203. PECO Comments at 32. [↑](#footnote-ref-203)
204. FirstEnergy Comments at 9, PECO Comments at 30-32 and PennFuture/KEEA Comments at 9. [↑](#footnote-ref-204)
205. 2013 TRM Final Order at 52-54. [↑](#footnote-ref-205)
206. *See* U.S. DOE UMP at 7-27. [↑](#footnote-ref-206)
207. FirstEnergy Comments at 7, PPL Comments at 7 and 8 and PECO Comments at 16 and 18. [↑](#footnote-ref-207)
208. PECO Comments at16. [↑](#footnote-ref-208)
209. PennFuture/KEEA Comments at 10. [↑](#footnote-ref-209)
210. *Ibid*. [↑](#footnote-ref-210)
211. PECO Comments at 28 and 29 and PPL Comments at 11 and12. [↑](#footnote-ref-211)
212. PPL Comments on at 11 and 12. [↑](#footnote-ref-212)
213. Penn Future/KEEA Comments at 8. [↑](#footnote-ref-213)
214. PECO Comments at 47 and PennFuture/KEEA Comments at 7. [↑](#footnote-ref-214)
215. PECO Comments at 58, PennFuture/KEEA Comments at 8 and PPL Comments at 15. [↑](#footnote-ref-215)
216. *See* 42 U.S.C.A. § 6295(g)(8) [↑](#footnote-ref-216)
217. *See* 2013 TRM Final Order at 95. [↑](#footnote-ref-217)
218. *See* Section 6.5.3, page 239, of the 2012 Illinois TRM. [↑](#footnote-ref-218)
219. Program Year 7 runs from June 1, 2015, through May 31, 2016. [↑](#footnote-ref-219)
220. EUL adjustments are calculated by applying the savings adjustment factor to the remaining useful life of the measure and reducing the EUL accordingly. The savings adjustment factor methodology and the adjusted EUL methodology will produce the same lifetime savings. [↑](#footnote-ref-220)
221. The Phase II C&I Baseline Study is outlined in the Commission’s Phase II SWE Contract available at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/act_129_statewide_evaluator_swe_.aspx>. [↑](#footnote-ref-221)
222. PennFuture/KEEA Comments at 11 and FirstEnergy Reply Comment at 2. [↑](#footnote-ref-222)
223. PennFuture/KEEA Comments at 12. [↑](#footnote-ref-223)
224. *Ibid*. [↑](#footnote-ref-224)
225. PennFuture/KEEA Comments at 14. [↑](#footnote-ref-225)
226. PECO Comments at 62. [↑](#footnote-ref-226)
227. PECO Comments at 62. [↑](#footnote-ref-227)
228. Duquesne Comments at 7. [↑](#footnote-ref-228)
229. Northeast Energy Efficiency Partnerships, Mid Atlantic TRM Version 2.0. July 2011. [↑](#footnote-ref-229)
230. Northeast Energy Efficiency Partnerships, Mid Atlantic TRM Version 3.0. March 2013. [↑](#footnote-ref-230)
231. FirstEnergy Comments at 10-12. [↑](#footnote-ref-231)
232. *Id.* [↑](#footnote-ref-232)
233. PPL Comments at 15 and 16. [↑](#footnote-ref-233)
234. PPL Comments at 16. [↑](#footnote-ref-234)
235. Connecticut Program Savings Documentation for 2012 Program Year, United Illuminating Company, September 2011. [↑](#footnote-ref-235)
236. eQUEST stands for “the Quick Energy Simulation Tool” which is a building energy analysis tool used to perform detailed analysis of today's state-of-the-art building design technologies. More information regarding the software can be found at: <http://doe2.com/equest/>. [↑](#footnote-ref-236)
237. *See Pennsylvania Statewide Commercial and Industrial End Use and Saturation Study*, (PA C&I Baseline Study), prepared for the Pennsylvania Public Utility Commission, performed by GDS Associates, *et al.*, submitted April 18, 2012. [↑](#footnote-ref-237)
238. PennFuture/KEEA Comments at 13. [↑](#footnote-ref-238)
239. FirstEnergy Comments at 12 and PPL Comments at 16. [↑](#footnote-ref-239)
240. PennFuture/KEEA Comments at 13. [↑](#footnote-ref-240)
241. <http://www.deeresources.com/>. [↑](#footnote-ref-241)
242. PennFuture/KEEA Comments at 13 and FirstEnergy Reply Comments at 2. [↑](#footnote-ref-242)
243. FirstEnergy Comments at 6 and PennFuture/KEEA Reply Comments at 3. [↑](#footnote-ref-243)
244. PECO Comments at 63. [↑](#footnote-ref-244)
245. Connecticut Program Savings Documentation for 2012 Program Year, United Illuminating Company, September 2011. [↑](#footnote-ref-245)
246. <http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_CAC.xls>. [↑](#footnote-ref-246)
247. eQUEST stands for “the Quick Energy Simulation Tool” which is a building energy analysis tool used to perform detailed analysis of today's state-of-the-art building design technologies. More information regarding the software can be found at: <http://doe2.com/equest/>. [↑](#footnote-ref-247)
248. UI and CL&P Program Savings Documentation for 2012 Program Year, United Illuminating Company, September 2011. [↑](#footnote-ref-248)
249. PECO Comments at 64. [↑](#footnote-ref-249)
250. ASHRAE 90.1-2007, Addendum S. [↑](#footnote-ref-250)
251. PECO Comments at 64. [↑](#footnote-ref-251)
252. <http://neep.org/emv-forum/forum-products-and-guidelines/> [↑](#footnote-ref-252)
253. PECO Comments at 8*.* [↑](#footnote-ref-253)
254. *Ibid*. [↑](#footnote-ref-254)
255. PECO Comments at 65. [↑](#footnote-ref-255)
256. Northeast Energy Efficiency Partnerships, Mid Atlantic TRM Version 3.0. March 2013. [↑](#footnote-ref-256)
257. PECO Comments at 42. [↑](#footnote-ref-257)
258. PennFuture/KEEA Comments at 14. [↑](#footnote-ref-258)
259. PECO Comments at 65. [↑](#footnote-ref-259)
260. *Id*. [↑](#footnote-ref-260)
261. *Id.* [↑](#footnote-ref-261)
262. *Id*. [↑](#footnote-ref-262)
263. See Section 3.16, pages 273, of the draft 2014 TRM. [↑](#footnote-ref-263)
264. PPL Comments at 16 and 17. [↑](#footnote-ref-264)
265. PennFuture/KEEA Comments at 12. [↑](#footnote-ref-265)
266. ASHRAE 90.1-2007, Addendum S. [↑](#footnote-ref-266)
267. Are They Cool(ing)?: Quantifying the Energy Savings from Installing/Repairing Strip Curtains, Taghi Alereza, Sasha Baroiant, Donald R. Dohrmann, Daniel Mort, ADM Associates, Inc., Sacramento, CA. [↑](#footnote-ref-267)
268. PECO Comments at 66. [↑](#footnote-ref-268)
269. *See Commercial Facilities Contract Group 2006-2008 Direct Impact Evaluation*, Study ID: PUC0016.01, Performed by ADM Associates Inc., *et al.*, for the California Public Utilities Commission, February 28, 2010. [↑](#footnote-ref-269)
270. PECO Comments at 66. [↑](#footnote-ref-270)
271. PECO Comments at 66 and 67. [↑](#footnote-ref-271)
272. PECO Comments at 67. [↑](#footnote-ref-272)
273. <http://neep.org/emv-forum/forum-products-and-guidelines/> [↑](#footnote-ref-273)
274. PECO Comments at 64. [↑](#footnote-ref-274)
275. *See* 2013 TRM Final Order at 110. [↑](#footnote-ref-275)
276. PECO Comments at 67. [↑](#footnote-ref-276)
277. PennFuture/KEEA Comments at 12 and 13. [↑](#footnote-ref-277)
278. PECO Comments at 68. [↑](#footnote-ref-278)
279. Residential and Commercial Industrial Lighting Measures Coincidence Factor Study, RLW Analytics, spring 2007. [↑](#footnote-ref-279)
280. <http://www.nwcouncil.org/energy/rtf/measures/measure.asp?id=95&decisionid=117>. [↑](#footnote-ref-280)
281. *See* page 2013 TRM Final Order at 98. [↑](#footnote-ref-281)
282. PennFuture/KEEA Comments at 14. [↑](#footnote-ref-282)
283. Work papers developed by SCE filed with the CA PUC in support of its 2006 – 2008 energy efficiency program plans. [↑](#footnote-ref-283)
284. Southern California Edison Company, Design & Engineering Services, Work Paper WPSCNRRN0001, Door Gaskets for Main Door of Walk-in Coolers and Freezers. [↑](#footnote-ref-284)
285. PECO Comments at 68. [↑](#footnote-ref-285)
286. PECO Comments at 68-70. [↑](#footnote-ref-286)
287. *See* 2013 TRM Final Order at 100. [↑](#footnote-ref-287)
288. PECO Comments at 70 and 71 and FirstEnergy Comments at 12. [↑](#footnote-ref-288)
289. *See* 2013 TRM Final Order at 105. [↑](#footnote-ref-289)
290. PECO Comments at 71. [↑](#footnote-ref-290)
291. *Id*. [↑](#footnote-ref-291)
292. PECO Comments at 72. [↑](#footnote-ref-292)
293. *Id*. [↑](#footnote-ref-293)
294. PennFuture/KEEA Comments at 13. [↑](#footnote-ref-294)
295. PECO Comments at 72. [↑](#footnote-ref-295)
296. PECO Comments at 62, 83 and 84. [↑](#footnote-ref-296)
297. PennFuture/KEEA Comments at 12. [↑](#footnote-ref-297)
298. FirstEnergy Comments at 13. [↑](#footnote-ref-298)
299. PECO Comments at 84. [↑](#footnote-ref-299)
300. FirstEnergy Comments at 12. [↑](#footnote-ref-300)
301. EAP Comments at 4, FirstEnergy Comments at 4, PPL Comments at 1-3 and PPL Reply Comments at 3. [↑](#footnote-ref-301)
302. PennFuture/KEEA Comments at 1 and Reply Comments at 2. [↑](#footnote-ref-302)
303. *See* 2011 TRM Final Order at 49,2012 TRM Final Order at 72 and 2013 TRM Final Order at 118. [↑](#footnote-ref-303)
304. *See* 2011 TRM Final Order at 49 and 50, 2012 TRM Final Order at 72 and 2013 TRM Final Order at 118 and 119. [↑](#footnote-ref-304)
305. *See* Phase II Implementation Order at 75; 2013 TRM Final Order at 118-120; 2012 TRM Final Order at 71-73; 2011 TRM Update Order at 47-50. [↑](#footnote-ref-305)
306. *See* Phase II Implementation Order at 75. [↑](#footnote-ref-306)